OBSERVATIONS ON *CHYZERIA* CANESTRINI AND SOME RELATED GENERA (ACARINA: TROMBIDIOIDEA) WITH REMARKS ON THE CLASSIFICATION OF THE SUPERFAMILY AND DESCRIPTION OF A PYGMEPHORID MITE PHORETIC ON *CHYZERIA*

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(Manuscript accepted 27 January 1981)

ABSTRACT

SOUTHCOTT, R. V. 1982. Observations on *Chyzeria* Canestrini and some related genera (Acarina: Trombidioidea) with remarks on the classification of the superfamily and description of a pygemphorid mite phoretic on *Chyzeria*. *Rec. S. Aust. Mus.* **18** (14): 285-326.

The taxonomy of the Australian larvae of the genus *Chyzeria* Canestrini, 1897, is revised. Two new species, *Chyzeria flindersi* sp. nov., from Tasmania, and *C. derricki* sp. nov., from Queensland, are described. In addition, the larva of *C. hirsti* Womersley, 1934 is redescribed from material reared in South Australia. The species *Grossia onychia* Womersley, 1954 is redescribed, from the type specimen from Victoria, and placed in *Chyzeria* as *C. onychia* (Wom.), comb. nov.

Details of the rearing of larvae of *C. hirsti* from adult specimens are given. The species appears to be viviparous, and the larvae are carried phoretically on the mother's back. Such behaviour allows some allotment of function to the digitations upon the dorsum of the adult, and the specialized hair characteristics of the intervening area. Parasitization of larval *Chyzeria* upon a host is recorded only in two instances, these being the record of the type series of *C. derricki* sp. nov. on an unidentified tettigoniid grasshopper, and the earlier record of *C. onychia* (Womersley) parasitizing an adult identified by Womersley as *Chyzeria australiensis* Hirst.

A description of the adult of *Chyzeria hirsti* Womersley (elevated from a subspecies to a species here) from the holotype is given, and some comparison made with the *Chyzeria australiensis* Hirst, 1928, type series from Western Australia.

The classification of the larvae of *Chyzeria, Grossia, Audyana* and others is examined. *Grossia* is considered a synonym of *Chyzeria*. These genera are removed from the subfamilies Apoloniinae and Lasseniinae, where they have been placed by some authors, to the family Trombellidae Feider 1955 (earlier subfamily Trombellinae Thor, 1935) of the Trombidioidea. Larvae of an Australian species of *Womersleyia* Radford are recorded as parasitic upon the cricket *Teleogryllus commodus* (Walker), in northern New South Wales, and nymphs reared experimentally are placed in *Trombella adelaideae* Womersley, 1939, thus allowing the synonymizing of *Womersleyia* with *Trombella* Berlese, 1887. This defines a further larval form of the Trombellidae.

The relationships of some of the genera, families and subfamilies of the Trombidioidea are briefly examined.

A new species of pygmephorid mite (Tarsonemida) is recorded as phoretic upon the dorsum of an adult *Chyzeria hirsti* Wom., and described as *Bakerdania workandae* sp. nov.

INTRODUCTION

In this paper the author records a number of observations on the morphology and biology of the genus *Chyzeria* Canestrini, 1897, with particular reference to the larvae. This genus belongs to the family Trombidiidae (s. l.) of the superfamily Trombidioidea Banks, 1894,* a group of prostigmatic mites which exhibit extreme heteromorphy between the adults (and mobile nymphs) and the larvae. This heteromorphy is in fact so great that in the superfamily the adults and larvae cannot be correlated with each other without experimental rearing. As both larvae and adults have to be described under separate names until such correlations are established, classificatory systems for the post-larval forms may not, and in fact often do not, correspond to that for the larvae, with inevitable confusion, and, in a number of cases, nomenclatorial difficulties. The present paper attempts to place the classification of the larvae related to *Chyzeria* on a firm basis, with detailed descriptions, and biological data where available. Two new species of larval *Chyzeria* will be described, and additionally, two previously recorded species will be redescribed, one being *C. onychia* (Womersley, 1954), n. comb., previously *Grossia onychia* Wom.

*Although this superfamily name was first proposed as such by Banks in 1894, under Article 36 of the International Code of Zoological Nomenclature, 1961, all categories in the family-group (which includes the superfamily category) are of co-ordinate status. As it is generally accepted that the family name Trombidiidae was first validly proposed by Leach in 1815 as "Trombidides", the superfamily name Trombidioidea is available from the year 1815 (See Oudemans, 1937; Thor and Willmann, 1947; Southcott, 1957d).

The trombidiid mite genus *Chyzeria* was founded by Canestrini in 1897, with the adult *C. ornata* Canestrini, 1897, as the type species, collected at Friedrich Wilhelmshafen (later Madang) in New Guinea. Since that time several further species have been described from Australia (including Tasmania), New Zealand, Africa and South America (Hirst 1924, 1928a, b, 1929; Womersley 1934, 1942; Lawrence 1944; Thor and Willmann 1947; André and Lelievre-Farjon 1960).

The three genera *Trombella* Berlese, 1887, *Chyzeria* and *Parachyzeria* Hirst, 1926, based on adults, were placed in the subfamily Trombellinae Thor, 1935 by Thor and Willmann (1947) in their monographic review of the taxonomy of the family Trombidiidae; this subfamily was separated from all others of the Trombidiidae on the ground of its lack of a crista metopica. Within the subfamily, adults of *Chyzeria* are distinct in possessing a series of digitations arranged around the rim of the dorsum of the idiosoma. These digitations are covered by two types of normal body setae (scobalae): one stiff and swordlike, the other flexible, longer and ciliated. In between these digitations the central dorsal area of the idiosoma is covered with another type of modified scobalae. In at least two Australian species, *C. australiensis* Hirst and *C. hirsti* Womersley, these last-named setae are modified to long, unciliated, highly convoluted hairs.

The genus *Parachyzeria*, known from Africa and Asia, is similar to *Chyzeria*, with a central area of modified setae dorsally upon the idiosoma (these being long and straight), but lacks the peripheral processes.

No suggestion has been made as to the possible function of the peculiar structural adaptations of these mites, although in the case of *Chyzeria*, the opportunity to do so, to at least some degree, existed over 40 years ago.

In 1938 I made a series of attempts to correlate larval and postlarval forms of trombidiid mites by experimental rearings, using South Australian material. Among genera reared, and made available to Herbert Womersley, then Entomologist, South Australian Museum, was *Chyzeria*. These larvae were described by Womersley in 1939, and allotted to *Chyzeria australiensis* Hirst, 1928, despite the fact that all adult *Chyzeria* from the "Adelaide District" he had examined earlier (Womersley, 1934) were allotted by him to *C. australiense* (sic) var. *hirsti* Wom. 1934.

I had seen these reared larvae in captivity on the adult's back. At times they ventured away to the soil below and then returned to the protection presumably afforded by the dorsum of the idiosoma of the parent. These observations were recounted to Womersley and offered for incorporation in his article, but although he was prepared to describe the larvae with their unusual morphological structure, he chose not to include the observations, possibly doubting their accuracy or relevance, or more likely being little interested in details of mite behaviour.

Womersley recognized that these larval mites, with their bizarre complement of dorsal and ventral setae, as well as unusual palp and (pedi)tarsal claw structure, were very different from any previously described trombidiid mites. They will be placed here as *Chyzeria hirsti* Womersley, 1934.

After returning to South Australia from military duties I made a number of attempts to rear larvae of *Chyzeria*, and on three further occasions I obtained larvae from adults. These experiments are recorded below, and confirm the larva-adult correlation originally seen in 1938.

The larval *Chyzeria hirsti* has each of its three pairs of legs 7-segmented (including the coxa); i.e. its leg segmental formula is 7, 7, 7. Its leg coxae have two setae upon coxa I, and one each upon coxae II and III, i.e. its leg coxal formula is 2, 1, 1.

In late 1945 I captured a larval trombidiid mite at Lake St. Clair, Tasmania, walking up the trunk of a eucalypt. This mite was very similar to the larval *Chyzeria hirsti*, and was clearly referable to the same genus. It had a trifid palpal tibial claw, 7-segmented legs, dorsal idiosomal setae placed upon expanded plates, leg coxal formula 2, 1, 1, and a number of other resemblances. The most obvious difference lay in the lack of modification of the scutalae, particularly the AL scutalae. This specimen is described in the present paper as the holotype of *Chyzeria flindersi* sp.nov.

In 1954 Womersley (p. 111) described as a new genus and species *Grossia onychia* Wom. 1954, a larval trombidiid mite which had been collected attached to an adult identified as *Chyzeria australiensis* Hirst in the Otway Ranges, Victoria, in 1951.

In 1947 Wharton had revised the classification of the subfamilies of the chigger mites, family Trombiculidae Ewing 1929*, separating them on the characters shown in Table 1.

*Formally proposed as such by Ewing (1944).

TABLE 1. CLASSIFICATION OF SUBFAMILIES OF TROMBICULIDAE, AS PROPOSED BY WHARTON (1947).

	Leg segmental formula	Coxal setal formula	Tracheae	Median scutal setae	Anterior scutal projection	Sternal setae
Subfamily Leeuwenhoekiinae Womersley (1944) (= Leeuwenhoekiidae, Womersley, 1944*	6, 6, 6	2, —, —	Present	Frequently 2	(?Frequently) present	No more than 2
Subfamily Walchiinae Ewing, 1946	7, 6, 6	1, —, —	Absent	(1)	(Absent)	At least 4
Subfamily Apoloniinae Wharton, 1947	7, 7, 7	1, —, —	Present	(1-2)	Present	(4)
Subfamily Trombiculinae Ewing, 1929	7, 7, 7	—, —, —	Absent	1	Absent	At least 4

*Formally proposed as such by Womersley (1945).

Womersley's *Grossia onychia* has a leg segmental formula 7, 7, 7, and a leg coxal formula of 2, 1, 1. He placed it in the subfamily Apoloniinae, whose definition had been enlarged by Wharton and Fuller in 1952, to accommodate the genus *Sauracarella* Lawrence 1949, which has a leg segmental formula of 7, 7, 7, but with a coxal setal formula of 1, 1(2), 1 and lacked tracheae, and also has expanded sensillary setae; the earlier criterion of "posterior lateral scutal setae not on the scutum" was omitted.

In the same paper (1954a) Womersley revised the taxonomy of a number of larval mites he placed in the family Leeuwenhoekiidae, subfamily Apoloniinae. In addition to the larval genera that he declared had been placed in the Apoloniinae by previous authors—*Apolonia* Torres and Braga, 1938 and *Womersleyia* 'Wharton' (actually the genus placed there by Wharton in 1947 was *Womersia* Wharton, 1947) and *Sauracarella* Lawrence, 1949—he included formally six further genera, these being *Cockingsia* Womersley, 1954, *Audyana* Womersley, 1954, *Mackerrasiella* Womersley, 1954, *Neotrombidium* Leonardi 1901 (with *Monunguis* Wharton 1938 as a synonym), *Grossia* nov., *Nothotrombicula* Dumbleton, 1947 and *Womersleyia* Radford, 1946. In his paper Womersley stated that 'This is a heterogeneous assemblage of genera', which subsequent studies have amply confirmed. The genus *Mackerrasiella* has been shown by Vercammen-Grandjean (1972) to be one of the Hydrachnellae, genus *Hydryphantes* Koch, 1841 and falls in synonymy. The genus *Audyana* was placed alternatively, in the same paper by Womersley, in the subfamily Trombellinae Thor 1935, since larvae had been reared to nymphs resembling *Trombella*, in Malaya. Additionally it may be commented that of the genera listed by Womersley, *Grossia*, *Nothotrombicula* and *Womersleyia* have leg segmental formula 7, 7, 7, while *Cockingsia*, *Audyana* and *Mackerrasiella* have leg segmental formula 7, 6, 6. Womersley (*loc. cit.*) included also in his key to the genera the genera *Neotrombidium* Leonardi, 1901 and *Monunguis* Wharton, 1938, stating in error that they had leg segmental formula 7, 7, 7; actually in *Neotrombidium* it is 7, 6, 6, and in *Monunguis* 6, 6, 6, which Womersley eventually recognized (published posthumously (Womersley, 1963)).

The resemblance between the larvae of *Chyzeria* as described by Womersley in 1939, *Grossia onychia* Wom. 1954, and *Nothotrombicula deinacridae* Dumbleton, 1947, from New Zealand is striking, but in this (1954a) paper Womersley made no reference to it. Evidently, by 1953-1954, he had forgotten his 1939 description. Another possible factor may have been the inaccuracies in his account of the *Chyzeria* larva, of which the claws of the tarsi of the legs were stated to have 'claws three, the lateral ones clavate . . .' while in *Grossia* each leg tarsus was stated to possess 'paired spathulate setae on each tarsus at the base of the single claw', these lateral claws also being referred to as 'a pair of shorter [than the central tarsal claw] apically spathulate tenent setae'. Both *Grossia onychia* and *Nothotrombicula deinacridae* have been redescribed by Vercammen-Grandjean (1972), as possessing spathulate neolateral pedotarsal claws (see the anatomical terminology in Southcott 1961a).

In 1968 Vercammen-Grandjean and Kolebinova revised the subfamily Apoloniinae, restricting it to seven species, allotted among six genera; these were arranged in two tribes, the Apoloniini and the Sauracarellini. They rejected all of the genera included in the Apoloniinae by Womersley (1954a), with the exception of the type genus *Apolonia*.

As stated above, Vercammen-Grandjean (1972) reexamined the status of the mites that Womersley had placed in his greatly expanded Apoloniinae. He placed both *Grossia* and *Nothotrombicula* in the subfamily Lasseninae (sic, for Lasseniinae) Newell, 1957, of the family Johnstonianidae Thor, 1935* (formerly Johnstonianinae Thor, 1935). Vercammen-Grandjean made no reference in his paper to the larval *Chyzeria* that Womersley had described in 1939.

* Formally elevated as such by Newell (1957).

The subfamily Johnstonianinae had been founded by Thor in 1935 for those (adult) Trombidiidae, in which a distinct crista metopica is present, with two pairs of dorsal sensilla, together with some minor and less specific features. This was a distinct group, elevated to family status as Johnstonianidae by Newell (1957), in a study of a series of trombidioid mites from Hawaii and North America, on the ground that these mites differed so profoundly from other terrestrial Parasitengona that they could not logically be retained in the old family Trombidiidae. The differences were, in fact, greater than used by Ewing to separate off the family Trombiculidae from the remaining Trombidiidae. In that study Newell included seven genera in the family, which he divided into the subfamilies Johnstonianinae Thor and Lasseniinae Newell, 1957. The latter subfamily was erected for the general *Lassenia* Newell, 1957, *Polydiscia* Methlagl, 1928 and *Crossothrombium* Womersley, 1939. *Lassenia* was founded on *L. lasseni* Newell, 1957 as type genus, an adult mite in which the principal character was the great reduction of the anterior sensilla when compared with the posterior sensilla. As well as two species of adults, Newell *(loc. cit.)* described two species of larvae, which he placed in the genus on morphological characters and field association, but without the confirmation of experimental rearing. In these larvae the dorsal scutum carries two pairs of normal setae (scutalae) as well as the two pairs of sensilla. Newell made no reference to any genera of Trombiculidae (Trombiculinae) nor the Leeuwenhoekiidae (Leeuwenhockiinae), nor to the genus *Chyzeria* or other Trombellinae.

In 1973 Vercammen-Grandjean submitted a classification of the Trombidioidea, divided into eight families and a number of subfamilies and tribes. Among the families considered were listed Trombellidae, Johnstonianidae, Neotrombidiidae nov., and Leeuwenhockiidae. In that revision he placed *Chyzeria* in the Trombellidae and *Grossia* in the Johnstonianidae. *Womersleyia* appears to have been omitted.

As it is not possible in the present paper to deal with the overall classification of the Trombidioidea, it is proposed to submit a detailed examination of the status of the genera *Chyzeria* and *Grossia*, and to make some incidental reference to some other taxa, in an effort to clarify the relationships of several genera of the Trombidioidea.

Table 2 lists a number of genera of larval Trombidioidea which have been referred to either the Trombellinae, Leeuwenhoekiinae (Leeuwenhockiidae), Lasseniinae or Apoloniinae by various authors, as well as several genera of other families of the superfamily Trombidioidea which are included for purposes of comparison.

TABLE 2. POSSIBLY SIGNIFICANT GENERIC CHARACTERS FOR THE LARVAE* IN A NUMBER OF THE SUPERFAMILY TROMBIDIOIDEA.

	Cx1	Cx2	Cx3	LI	LII	LIII	AM	PL	Nas	Claws	SS	
Chyzeria	2	1	1	7	7	7	0	2	0	3	2	
Grossia	2	1	1	7	7	7	0	2	0	3	2	
Nothotrombicula	2	1	1	7	7	7	0	2	1	3	2	
Chatia	2	1	5-7	6	6	6	2	2	0	2	2	
Monunguis	1	1	1	6	6	6	2	2	1	1	2	
Neotrombidium	2	1	1	7	6	6	2	2	1	1	2	
Cockingsia	2	1	1	7	6	6	2	2	1	1	2	
Leeuwenhoekia	2	1	1	6	6	6	2	2	1	3	2	T
Audyana	2	1	1	7	6	6	2	2	0	1	2	
Apolonia	1	1	1	7	7	7	2	0	1	3	2	T
Womersia	1	1	1	7	7	7	1	0	1	3	2	T
Womersleyia	2	1	1	6	6	6	2	2	1	1,1,2	2	
Mackerrasiella (= *Hydryphantes*)	2	1	1	7	7	7	0	?2	0	1	?4	
Eutrombicula	1	1	1	7	7	7	1	2	0	3	2	
Babiangia	1	1	1	7	7	7	1	2	0	3	2	
Odontacarus	2	1	1	6	6	6	2	2	1	3	2	T
Vatacarus	1	1	1	7	7	7	1	2	0	3	2	
Pteridopus	2	1	1	7	7	7	0	2	(1)	3	4	
Polydiscia	2	1	2	7	7	7	0	2	(1)	3	4	
Durenia	2	1	1	6	6	6	2	2	1	1,1,2	2	T
Taraxithrombium	2	1	1	7	6	6	2	2	1	1	2	
Podothrombium	2	1	1	6	6	6	2	2	1	3	2	
Ralphaudyna	2	1	1	7	7	7	0(?2)	2	1	3	4(2?)	
Walchia	1	1	1–3 (+)	7	6	6	0	2	0	3	2	
Lassenia lasseni	2	2	3–4	6	6	6	0	2	0	3	4	
Lassenia scutellata	2	1	2	6	6	6	0	2	0	3	4	
Sauracarella	1	1(2)	1	7	7	7	2	2	1	3	2	

T Tracheae present

* The listing of a genus in this Table does not imply that I necessarily accept that these genera are all distinct from each other; nor that they are particularly related to each other.

The abbreviations used are Cx1, 2 and 3, the number of coxalae or setae upon the ventral surface of the coxae (i.e. omitting supracoxalae), L I, II and III, the numbers of segments in the legs, including the coxae (the traditional term coxae being used here, in place of terms introduced by later authors); AM, the number of anteromedian setae (scutalae) to the dorsal scutum; PL the number of posterolateral scutalae to the dorsal scutum; Nas, the presence (1) or absence (0) of a "nasus" or anterior projection to the dorsal scutum; SS, the total number of scutal sensilla. The information is derived from the most recent or accurate authorities on these data, as quoted in the list of references, or from the detailed descriptions given in the present paper.

It is clear that the classification of the larval Trombidioidea is not yet on a firm basis, since we have, for example, various classifications for a fairly homogeneous group of larvae related to *Chyzeria*, these having been placed in the subfamilies Trombellinae, Apoloniinae and Lasseniinae by different authors.

It is proposed in this paper to re-examine and redescribe the larvae of *Chyzeria* (including *Grossia*) from the further material now available, and to attempt to define the characters of the Trombellinae (Trombellidae) for larvae. The relationships of the genera *Neotrombidium*, *Monunguis* and *Cockingsia* have already been examined by the writer in other papers (Southcott 1954a. 1957c) as well as by others, and any further consideration will be deferred to later works. The larva of the genus *Audyana* Womersley, 1954, with its leg segmentation formula 7, 6, 6 and single-clawed pedotarsi, appears at first sight to be not particularly related to the Trombellinae considered here. Nevertheless, it has been correlated by rearing.

One further genus was placed by Womersley (1954a) in his expanded Apoloniinae, namely *Womersleyia* Radford, 1946. In an earlier draft of the present paper I had written that although this appeared to be a well-defined genus, there was no strong evidence to connect it with *Chyzeria*, *Grossia* and *Nothotrombicula* and had decided to exclude it from further consideration in the present paper. Recently, however, I have been sent a batch of larval orange-coloured mites taken as ectoparasites on adults of *Teleogryllus commodus* (Walker), the field cricket, collected 10 km N of Armidale, New South Wales, on 12 and 19 March 1980, by Mr Steve Davidson. These proved to be typical *Womersleyia*, but the leg segmentation formula is 6, 6, 6, and not 7, 7, 7, as recorded by Womersley (1954a, p. 114). (Vercammen-Grandjean (1972) had corrected this for *W. minuta* Radford.) It has been possible to rear a number of these larvae to nymphs, which are typical *Trombella*, keying down (as far as is possible for nymphs) to *Trombella adelaideae* Womersley, 1939, in the key of Womersley (1954b, p. 128).* The further description of these Australian larval *Trombella* and their nymphs will be dealt with in later papers.

A further genus referred to the Trombellidae was *Ralphaudyna* Vercammen-Grandjean *et al.*, 1974, this action being based on its morphology. It is interesting to note, however, that there are significant resemblances to those larvae allotted by Newell (1957) to *Lassenia* in the dorsal scutum and other features.

At the present time it is probably fair to consider that larval trombidioid mites which can reasonably be allotted to the Trombellidae are species ascribed to the genera *Chyzeria*, *Nothotrombicula*, *Womersleyia* (=*Trombella*), *Audyana* and *Ralphaudyna*.

*As a consequence, Radford's species is here re-named *Trombella minuta* (Radford, 1946), comb. nov

SUBFAMILY AND FAMILY CONSIDERATIONS

Within the family Trombidiidae Leach, 1815, as defined by Thor (1935) and Thor and Willmann (1947), a number of groups have been separated off into families, e.g.

Trombiculidae Ewing, 1929*, Leeuwenhoekiidae Womersley, 1944*, Vatacaridae Southcott, 1957, Johnstonianidae*, Calotrombidiidae (sic) Feider, 1959, and a number of others. Among these is the family Trombellidae (formally proposed as such by Feider (1955)), based upon the genus *Trombella* Berlese, 1887, and erected originally as the subfamily Trombellinae Thor, 1935.

Family Trombellidae Thor, 1935

Syn. Trombellinae Thor, 1935; Thor and Willmann, 1947; Trombellidae Feider, 1955

Definition

Trombidioid** mites lacking a crista metopica in the adult and active nymphal stages. Propodosoma carries a pair of dorsal sensilla. Definition of larva deferred.

Key to Larval Genera of the Family Trombellidae

1	Leg segmental formula 7, 7, 7	2
	Leg segmental formula 7, 6, 6 or 6, 6, 6	4
2 (1)	Dorsal scutum lacking anteromedian projection ("nasus")	*Chyzeria* Canestrini 1897

*See earlier comments in this paper on the formal dates on which these names were proposed.

**For a definition of Trombidioidea, see Southcott (1957d, p.173)

Dorsal scutum with anteromedian projection ("nasus") 3

3 (2) Dorsal scutum with 8 setae *Ralphaudyna* Vercammen-Grandjean *et al.* 1974

Dorsal scutum with 6 setae *Nothotrombicula* Dumbleton 1947

4 (1) Leg segmental formula 7, 6, 6 *Audyana* Womersley 1954

Leg segmental formula 6, 6, 6 *Trombella* Berlese 1887 (= *Womersleyia* Radford 1946)

Genus *Chyzeria* Canestrini

Chyzeria Canestrini 1897, p. 463; 1899, p. 390. Hirst 1924, p. 1077; 1928a p. 563; 1928b p. 1021; 1929 p. 165. Vitzthum 1931 p. 148; 1942 p. 286. Womersley 1934 p. 182; 1937, pp. 75, 76; 1939, p. 155; 1942, p. 169. Lawrence 1944 p. 438. Thor and Willmann 1947 p. 203. Baker and Wharton 1952 p. 250. Vercammen-Grandjean 1955 p. 260; 1973b p. 110. André and Lelièvre-Farjon 1960 p. 461. Southcott 1961a p. 563. André 1962 p. 124; 1963 p. 561. Vercammen-Grandjean and Kolebinbova 1968 p. 250. Robaux 1969 p. 69. Krantz 1978, p. 351.

Grossia (as larva) Womersley 1954a p. 111. Audy 1954 p. 166; 1957 p. 442. Vercammen-Grandjean 1967 p. 2; 1971b p. 315; 1972 p. 231; 1973a p. 58; 1973b p. 110. Robaux 1977a p. 666.

Type species: *Chyzeria ornata* Canestrini, 1897, (original designation)

Definition of Adult

Trombidiidae without well-defined crista metopica, but a shield may be present in the central area of dorsum of propodosoma. A pair of dorsal idiosomal sensilla may arise upon a protuberance usually anterior to the level of the eyes. Eyes 2 + 2, sessile. Dorsum of idiosoma with a lateral column of finger-like processes, covered with setae which may be of two distinct types, the one stiff and pointed, the other flexible. Additionally there may be a dorsal anteromedian projection arising about level with the most anterior of the dorsolateral projections, and a posteromedial projection. Area between the dorsal projections of the idiosoma with numerous fine, long, convoluted setae.

Definition of Larva

Trombidiid larvae with a single prodorsal scutum, transversely placed, with AL and PL scutalae placed towards AL and PL angles respectively of scutum. No anteromedian scutalae. A pair of scutal sensilla present, widely separated, placed at about the mid-level of scutum. Sensillary hairs filiform, ciliated. Eyes 2 + 2, conjoined, sessile, placed laterally or posterolaterally to scutum. Intercoxal formula 0, 0, 2. Pedocoxal formula 2, 1, 1. Legs with divided femora, i.e. leg segmental formula 7, 7, 7 (including coxae). Pedocoxalae may be short, stout, pointed, blunted, peg-like, smooth or irregular. Pedotarsal claws all rather slender: anterior terminating in expanded suction-membrane; middle (neomedian) claw normal, more or less falciform; posterior claw similar to anterior. Palpal tibial claw strong, divided into three strong divergent tines. Idiosomal setae may arise from small plates, these being expansions of the normal alveolar annulus of the seta. Ventral setae may have the basal part of the shaft (scobillum) thickened.

Key to Known Larvae of *Chyzeria*

1. AL scutalae short, blunt, robust, somewhat expanded, with short, strong serrations, about 17-20 μm long. Pedicoxalae short, blunted, multituberculate, with tubercles present along most of the setal shaft (scobillum). Posterior dorsal idiosomalae to about 46 μm long . . . *Chyzeria hirsti* Womersley, 1934 (South Australia)

AL scutalae normal, tapering, moderately pointed, more or less ciliated. Pedicoxalae either tapering, pointed and ciliated, or blunted and tuberculate, but in the latter case with the tubercles absent in the proximal half of the scobillum. Posterior dorsal idiosomal setae in range of 75-140 μm 2

2. (1) Pedicoxalae pointed or very slightly blunted. AL scutalae about 112 μm long; AL/(A-P)>2.1 *Chyzeria onychia* (Womersley, 1954) (Victoria)

Pedicoxalae very blunt-ended. AL scutalae in range of 55-107 μm long; AL/(A-P)<2.1 3

3. (2) Pedicoxalae weakly tuberculate through the distal half of the setal shaft (scobillum). AL scutalae about 55 μm long; AL/(A-P) about 1.06. Palpal tibial claw tines only slightly divergent *Chyzeria flindersi* sp. nov. (Tasmania)

Pedicoxalae weakly tuberculate in about the distal one quarter of the shaft of the seta (scobillum). AL scutalae in range of 88-107 μm long; AL/(A-P) 1.9-2.0. Palpal tibial claw tines widely divergent *Chyzeria derricki* sp. nov. (Queensland)

Chyzeria hirsti Womersley

(Figs. 1A, B; 2 A-E; 3; 4 A-D)

Chyzeria australiense (sic) var. *hirsti* Womersley, 1934 p. 182; Womersely 1937, p. 76 (as adult)

Chyzeria australiense (sic) Womersley, 1939, p. 155 (as larva)

Nec C. australiense (sic) Hirst 1928 (1928a) p. 563 (adult)

Description of Larva (based largely upon specimen ACB 13/14 L1) (Figs. 1A, B; 2A-G) Colour in life red. Length of idiosoma (mounted on slide) 285μm, width 190μm; total length of animal from tip of chelicerae to posterior pole of idiosoma 360μm.

Dorsal scutum about twice as wide as long, trapezoidal with somewhat rounded angles, the scutum widest posteriad. Anterior margin somewhat sinuous, posterior margin somewhat convex (a little angulated in the middle), lateral margins slightly concave. Scutal sensilla very widely separated, and behind level of middle of scutum. AL scutalae placed towards AL angles of scutum, PL scutalae towards PL angles of scutum.

TABLE 3. STANDARD AND OTHER DATA FOR SOME LARVAE OF *Chyzeria hirsti*

Designated variate	Specimen						
	ACB 13/14 L1	ACB 13/14 L2	ACB322 L1	ACB322 L2	ACB468 L1	ACB468 L2	ACB526 L1
AW	86	83	75	79	78	77	82
PW	110	116	104	96	110	107	109
SB	61	66	57	55	57	59	60
ASBa	39	37	35	33	28	28	38
ASBp	29	28	26	22	ca18	29	27
L	68	65	61	55	ca46	57	64
W	126	134	ca123	109	149	138	140
A-P	32	31	31	29	32	31	29
AI	18	19	20	17	18	19	17
PL	29	25	29	29	29	33	29
Sens	59	63	53	50	61	57	
DS	29-57	35-57	24-49	40-52	33-42	33-66	42-50
mid-DS	39-44	35-42	39-40	40	42	39-66	42
PDS	45	44	24-37	44	37-46	33-39	39-42

Anterior scutalae short, robust, spindle-shaped, ciliated, the cilia blunted, outstanding a little and thus the AL scutala resembles a distorted partly opened pine-cone with about 9 bracts; posterior scutalae rather longer, pointed, elongate-spindle-shaped, with projecting barbed pointed cilia. Scutal sensillary hairs slender, with distal sparse cilia.

Eyes 2 + 2, sessile, near PL angles of scutum; corneae oval to ovoid, posterior the larger. Anterior cornea has maximum diameter 15μm, posterior has maximum diameter 19μm.

Dorsal idiosomalae long, very slightly tapering, pointed, slightly ciliated with barbed cilia. Setae arise from small plates, oval or somewhat straight-edged where they impinge upon each other; plates are expansions of normal annuli of alveolar sockets; setae usually arise eccentrically upon the plates. Setae arranged 6, 6, 6, 6, 2; total 26.

Venter lacking setae on idiosoma between coxae I and II. Between coxae III a pair of radish-shaped setae, having an expanded basal part to the shaft (scobillum), the remainder long, tapering, pointed; setae 17μm long. Behind the level of coxae III are about 30 setae (apart from the four anals), similar to the last, arranged in somewhat irregular transverse rows across the ventral opisthosoma. These setae change in character as one proceeds posteriad. The more anterior setae are short and "radish-like" or "parsnip-like", with a thickened basal part of the scobillum and a maximum thickness at about the middle of the seta, and are similar to the pair between coxae III. All ventral idiosomal setae arise from small basal plates (expanded annuli). Posteriad the setae gradually become more elongate, more ciliated and stronger, but lose the bulbous expansion. Setae of anterior row are 16-21μm long, and the posterior setae to 37μm long. Anus with two oval valves, 45μm long by 37μm across with the valve lips in apposition. Each anal valve with two long setae, anterior pointed, ciliated 22μm long, posterior blunted, ciliated 28μm long. Idiosomal setae lateral to anus tapering, pointed, elongate, 35μm long.

Coxalae 2, 1, 1. All coxalae short, stout, unciliated, with indefinite coarse tuberculations in lateral aspect, and terminally somewhat bifid, resembling an irregular plum in shape; setae 9-11μm long by 5-7μm across. The tuberculations number about 7, and are placed more or less distally upon the setal shaft or scobillum.

Legs normal, with the distal ends of femora, genua and tibiae tending to expand. Leg I 375μm long, II 380μm, III 420μm (all lengths include coxae and claws). Leg scobalae normal, curved, ciliated, terminally pointed or blunted.

Tarsus 96μm long by 29μm high, tibia I 55μm long, genu I 46μm (TiI/GeI = 1.20); tarsus III 101μm long by 24μm high, tibia III 55μm, genu III 54μm (TiIII/GeIII = 1.01). (Tarsal lengths given exclude claws and pedicle.). Genu I with specialized seta VsGeI.77pd; tibia I with SoTiI.14ad, SoTiI.86ad, VsTiI.86pd. Genu II with specialized seta VsGeII.79pd. Tibia III with specialized seta SoTiIII.22pd. Tarsal setae as figured. Tarsal pedicle normal. Pedotarsal claws: anterior and posterior slender, spathulate, middle (neomedian) falciform, slender, unciliated, with sharp terminal downturned tip.

Gnathosoma rather small, compact, flattened pos-

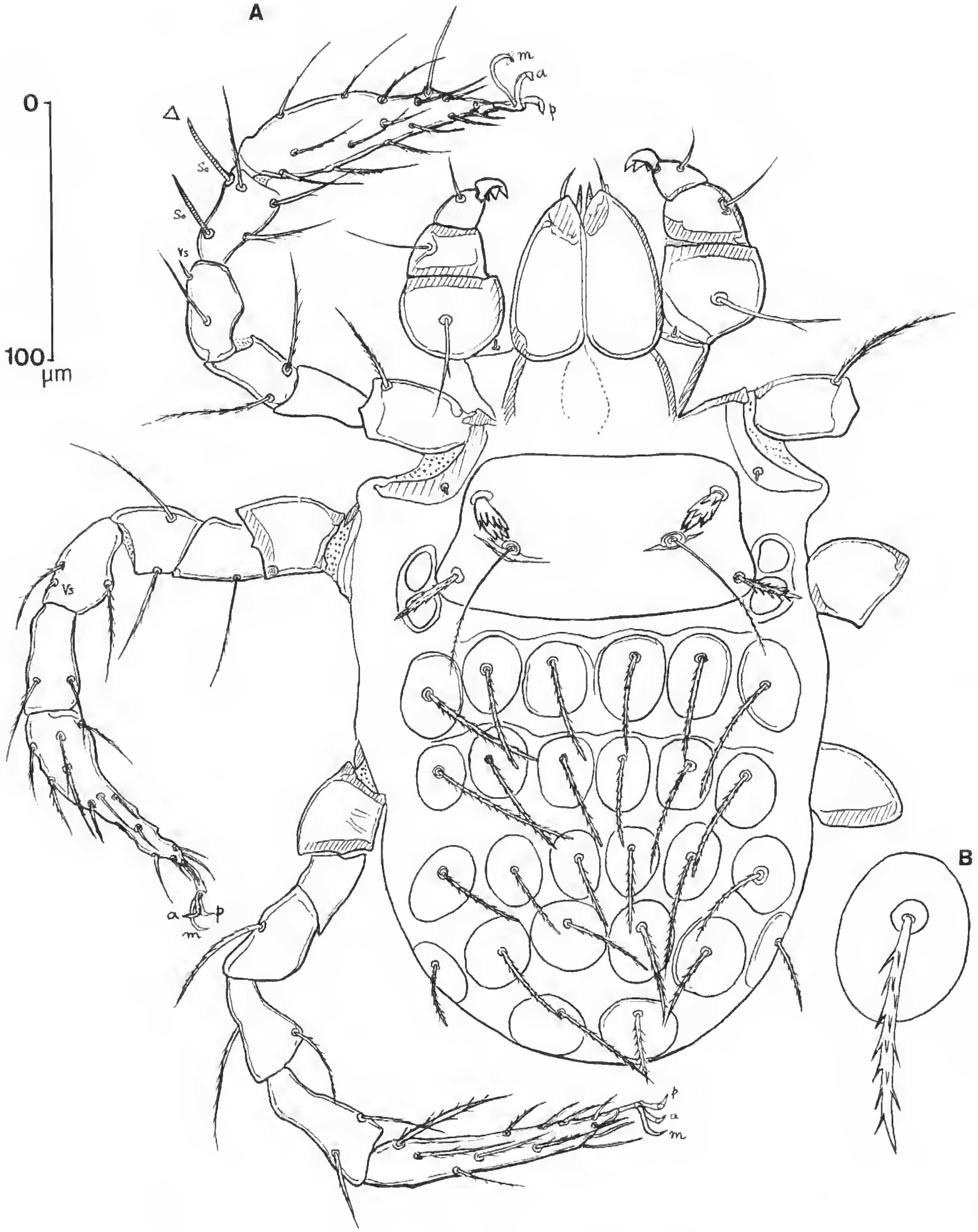

FIG. 1. *Chyzeria hirsti* Womersley, larva, specimen ACB13/14 L1. A, Dorsal view, legs on right hand side of figure omitted beyond trochanters; to scale on left. B, Detail of a dorsal idiosomal seta and its basal plate; not to scale.

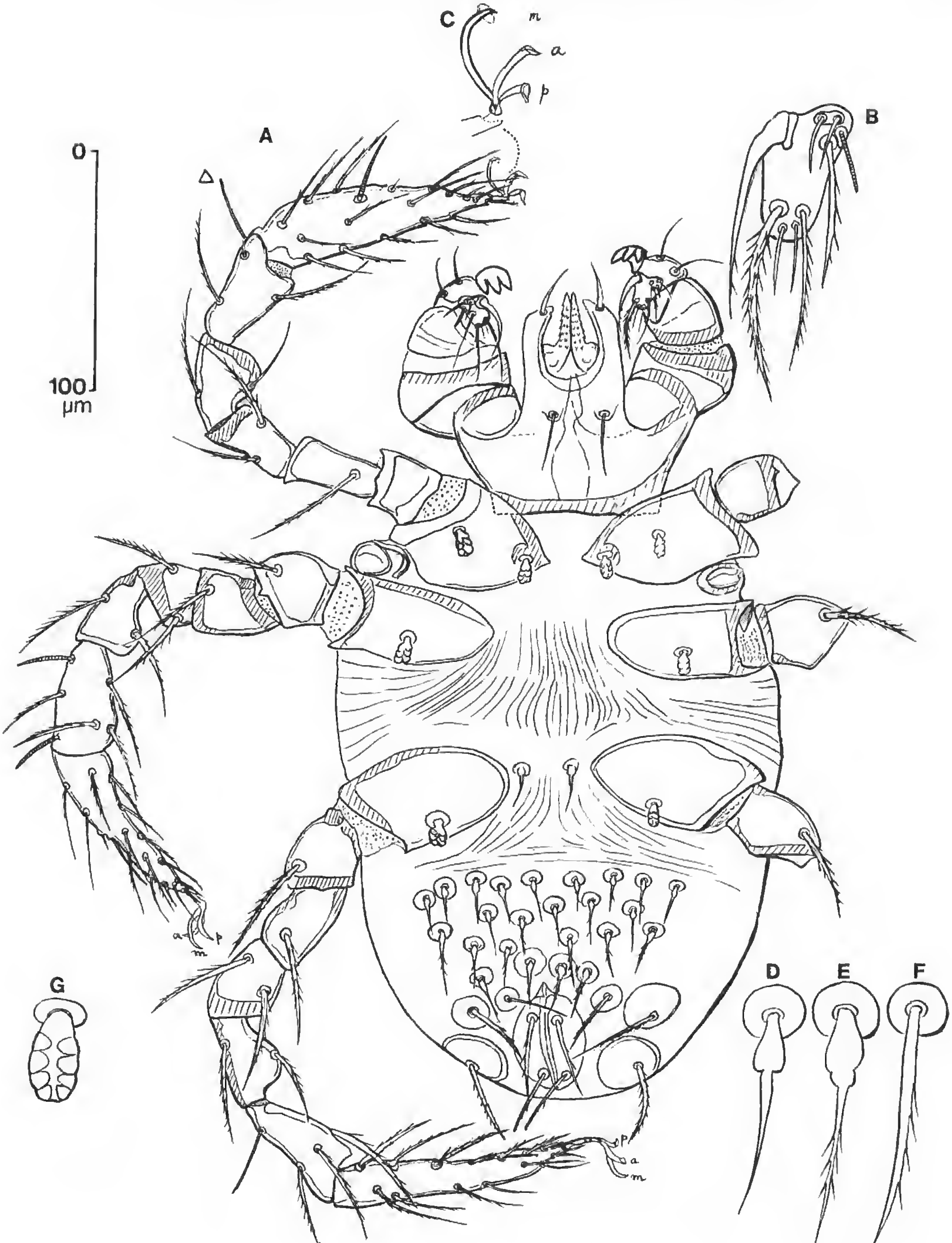

FIG. 2. *Chyzeria hirsti* Womersley, larva, specimen ACB13/14 L1. A, Ventral view, legs on right hand side of figure omitted beyond trochanters; to scale on left. B, Palpal tarsus, enlarged. C, Claws of tarsus I, enlarged. D, E, F, Posterior ventral idiosomal setae, enlarged. G, Pedocoxal seta, enlarged. (B-G not to scale.)

teriorly. Chelicerae bases 74μm long to tip of cheliceral blades, by 55μm across conjoined. Cheliceral blades small, curved, sharp-tipped, with small teeth along cutting edge and other surfaces. Galeala spiniform, robust, curved, simple, slightly blade-like, terminally pointed, 17μm long. A delicate circular lip surrounds the tip of the chelicerae. Anterior hypostomala not identified. Posterior hypostomala very slender, tapering, unciliated, 30μm long.

Palpi as figured. Palpal setal formula 0, 1, 1, 3, 9. Palpal femorala tapering, with one barbed ciliation, 37μm long. Palpal genuala tapering, pointed, unciliated, 26μm long. Palpal tarsal setae as figured. Palpal tibial claw (odontus) with three strong slightly divergent tines. Palpal supracoxala a slender blunted peg, 4μm long.

SOURCE OF *Chyzeria hirsti* LARVAE

Larvae of *Chyzeria hirsti* have been obtained on three occasions since 1938 by experimental rearing from the adults confined in tubes of soil.

(1) Serial ACB13, 14. Two adults were captured by the author on a hillside above the property of Birksgate near Glen Osmond, South Australia, on 23 May 1938. These mites were placed in a glass tube with a small amount of soil from their capture site. Local natural unsterilized soil* was used, as with all my similar attempts with many different trombidiids, on the hypothesis that the mites would find food in the form of fungi or small arthropods in the soil. Subsequent notes (abbreviated) were as follows.

13.vi.1938 Both (mites) active. One active and plump, the other smaller and less plump.

2.vii.1938 Both active and well.

10.vii.1938 As 2.vii.1938.

24.vii.1938 Alive and active. Some fresh [unsterilized] soil added.

14.viii.1938 Alive and active.

10.ix.1938 Both active on stimulation. One thin, one plump. One oribatid (mite) and one parasitid (mite were) seen in the tube. There were a number of larval trombid (iid)s seen in the tube. Six were mounted (on a slide). One (further) one was lost. The others (were) kept in the tube. The adults had larvae on their backs, but most of the larvae were free.

12.ix.1938 One larva put into formalin.

13.ix.1938 Adults alive and active. Not less than three larval trombid(iid)s were free, running around inside the tube. One *Chyzeria* adult had two larvae on the dorsum; the other adult had four larvae on the dorsum. The larvae were not attached by their mouthparts. They ran over the bodies of their parents, without leaving them. [I obviously assumed at the time, presumably from the larval behaviour, that both of the adults were parents of the mites, although in retrospect that conclusion may not have been justified.]

(On examination of the slide-mounted adults one finds that one specimen (ACB13/14A) is clearly a female, the body being clarified in the mountant to show it contains a slightly irregular ovoid egg measuring 295μm by 260μm. No evidence of internal chitinization in the egg is visible; a more definite statement cannot be made on account of the thickness of the setation. In the case of the other adult (ACB13/14B) the sex is indeterminate, as the mite's idiosomal structure is obscured by attached debris, and no eggs can be seen; the genitalia are also obscured.)

So there were at least 17 larvae in all (6 mounted on slide initially, one lost 10.ix.1938, one put in formalin 12.ix.1938, and not less than 9 in the tube).

14.ix.1938 Adults active. Several larvae on dorsum of each adult. None [was] attached by its mouthparts, but all were moving over the surface of the adult, and keeping to the posterior half of the adult for the most part. When on the dorsum of the adults the larvae moved one or two legs at a time, and quickly, with intervals in between so they moved forward jerkily.

Several larvae were seen running round [in] the tube.

One larva was seen to leave the adult by a leg, and to get several mm [away] from the adult, and then return to the dorsum by a leg. (Possibly the larvae reconnoitre [using] the adults as bases.). One larva was seen dead in the tube (lost [on] 17.ix.1938).

15.ix.1938 Adults active; one with 4, other with 3 or more larvae on it. None [was] attached by [its] mouthparts. Two larvae where seen free in the tube.

17.ix.1938 Two [larvae] were taken out (returned later) and put on my arm. They were watched with a strong lens, but neither showed any signs of wanting to pierce the skin. Each was watched for about three minutes. They ran quickly over the skin.

22.ix.1938 Adults active, each with one larva on the posterior part of the dorsum. Larvae not attached by mouthparts, moving as before. Four

* The statement by Womersley (1939, p. 156) that the soil was sterilized was an error on his part.

larvae seen running around tube. One larva seen dead in the tube.

Observations continued over the succeeding weeks. By 24 September 1938 all the larvae were dead, possibly by the tube being made dryer. The tube was then re-wetted. On 8 October 1938 the adults were active. On 22 October they were shrunken and feeble, and on 29 October were dead. On being slide-mounted neither was then seen to contain eggs, nor were eggs seen at any stage in the tube.

(2) Serial ACB322

On 1 August 1948 a very plump adult *Chyzeria* was captured in soil at Workanda Creek, National Park, Belair, South Australia. It was placed in a tube with a little soil. Although examined regularly during the period August to November no eggs or larvae were seen in the tube. On 7 December 1948 two dead larvae were seen in the tube. The adult mite was healthy on 28 December but was dead on 28 January 1949.

No eggs or live larvae were observed in the tube at any stage.

(3) Serial ACB468

An adult *Chyzeria hirsti* was captured at the same site on 3 September, 1950, placed in a tube with some damp soil, and examined as opportunity offered. On 29 October I recorded "Worm in tube. One yellow ?egg in tube. Tube quite damp". On 14 November seven larvae were counted in the tube, several being immobile, trapped in water droplets. The yellow object noted on 29 October remained unaltered in appearance, and I recorded in my notes "I do not doubt [that] it has nothing to do with the *Chyzeria*. To my mind this tube experiment establishes the viviparity of *Chyzeria*.*"

One active larva was then taken out of the tube and manipulated into repeated encounters with the adult, these manoeuvres being aided with a fine brush. Although placed on the back of the adult on three or four occasions, the larva showed no indication to remain there, at once hurrying off. I commented in my notes that the larva looked "in fact like a typical larval *Trombicula*" (the term *Trombicula* indicating here a larval trombiculid mite of the genus *Eutrombicula* and various other genera). On being replaced in the tube, further encounters occurred between the adult and the larva, but the larva made no attempts to climb on its presumed parent's back. The trapped larvae were in a row as though they had been recently laid in a regular fashion, the distance between successive larvae being about 5 or 6 times the length of an individual larva.

On 15 November a few larvae were still alive and healthy, but again no attempt for one to climb on the back of the adult was observed. By 4 December all larvae were dead. The adult appeared active and healthy. However, by 1 January the adult also was dead.

Thus in this experiment no phoretic relationships were observed.

(4) Serial ACB526

On 29 July, 1951 another adult *Chyzeria* from the same site was captured and confined in a tube with some soil. Observations were made at intervals. On 9 September no eggs or larvae were seen in the tube. At the next observation, on 24 October, the adult was recorded as being well, the tube damp. "One larva is present in the tube. It gives the impression of walking on tiptoes more than the larva of *Ettmülleria** etc.—in this it resembles *Trombicula* etc. I watched it encounter its parent several times. At one of these encounters it ran up its parent's leg, over its back and down another leg, then circled widely and returned to the moving parent and walked underneath it. It appears to be attracted by movement.....Only this one larva (was) seen; no egg seen."

On 20 November the tube was rather dry; the adult alive and well. Two dead larvae were seen in the tube.

On 25 November the tube was dry; the adult alive and well.

The adult remained alive until 29 December, but was dead on 27 January, 1952. Only one larva was enventually recovered from the tube.

The time relationships between the adults and the larvae in this experiment are summarized in Table 4.

*(When taken in conjunction with the previous observations).

*The larvae of *Echinothrombium willungae* (Hirst, 1931); see also a note in Southcott (1957a; p. 142).

TABLE 4. SUMMARY OF DATA ON TIME-RELATIONSHIPS OF ADULTS AND LARVAE IN SUCCESSFUL REARING EXPERIMENTS WITH *Chyzeria hirsti* WOM.

Experiment	ACB 13,14	ACB322	ACB468	ACB522
Adult(s) captured	23.v.1938	1.viii.1948	3.ix.1950	29.vii.1951
Larva(e) seen alive	10-22.ix.1938	—	14-15.xi.1950	24.x.1951
Larva first seen dead	14.ix.1938	7.xii.1938	15.xi.1950	20.xi.1951
All larvae dead	23-24.ix.1938	(7.xii.1948)	16.xi.1950-4.xii.1950	20.xi.1951
Adult(s) died	23-29.x.1938	29.xii.1948-28.i.1949	5.xii.1950-1.i.1951	30.xii.1951-27.i.1952

In summary, larvae have appeared on four occasions in tubes containing live adults of *Chyzeria hirsti* confined therein, with unsterile soil as a rearing chamber. Eggs have not been observed. Larvae have appeared alive between September and November and possibly are restricted mainly to the period September-October. No larva has been captured in the field, and at present these larvae are the only ones known of *Chyzeria hirsti*. No evidence of any potential host for these presumably parasitic larvae has been discovered. The adults are used by the larvae in a phoretic relationship, and there has been no evidence of parasitisation of the parent. Man does not appear to be a suitable host for the larva, from a single experiment. (This was expected; it is anticipated that eventually the larvae will be found to parasitise some arthropod host. See also the record for *Chyzeria derricki* sp.nov., below of parasitisation by this species of a tettigoniid host, and also the record for *Chyzeria onychia* (Wom.), in which this species was taken parasitic upon an adult *Chyzeria* sp.).

COMMENT ON LARVAL BEHAVIOUR IN *Chyzeria hirsti*

Although over the years 1938-1980 continued efforts have been made, as opportunity offered, to obtain *Chyzeria hirsti* (and other Trombidiidae) larvae from experimental preparations, the only successful attempts with *Chyzeria hirsti* have been those recorded above.

In two of the experiments recorded there was evidence of behavioural interaction between the larvae and the adult(s). In one further instance the observations were negative, while in the fourth experiment the larvae were dead when first observed.

There appears to be no doubt, however, that the larvae of *Chyzeria hirsti* have an unusual behaviour among Acarina, in that they have a phoretic relationship with their parents or parent. The evidence given above clearly indicates that the larvae use the adults as a means of transportation, and hence dispersion, this coming within the formal definition of phoresy. No doubt, in addition, the adults provide shelter and some degree of protection, in that being able to retreat to an elevated niche upon a parent represents some protection from predatory arthropods of a size capable of preying upon animals the size of the *Chyzeria* larva but not of the adult. This extends the relationship between the parent and the larva beyond transportation-utilization or phoresy, into one of protection. Similar extended relationships occur in other arachnids, perhaps the best known ones being in the case of scorpions and lycosid spiders, but such relationships occur widely among various groups of arthropods, particularly the Crustacea, and in fact even more widely and extensively in vertebrates. Thus not only is this seen frequently among Mammalia, but is well-known among Amphibia, and in fact the carrying of juveniles in the mouth or a brood-pouch is also known widely among the fishes.

Among the Acarina, however, although phoretic relationships between mites of a number of families and other arthropods are well-known (see Krantz, 1978), as far as I am aware there has been no previous record among the Acarina of phoretic behaviour occurring between an adult mite and the larva of the same species.

The observations above on maternal care of the larvae help to provide also some explanation for the peculiar structure of at least two species of *Chyzeria*. The dorsum of the idiosoma of the adult carries a number of largely peripheral projections. The area between these projections, in *C. australiensise* and *C. hirsti*, bears a dense mat of fine, convoluted, simple hairs.

In a recent paper Rovner *et al.* (1973) have suggested a possible role for the abdominal setation of the lycosid spiders in terms of maternal-juvenile behaviour. Adult female lycosids have peculiar knobbed hairs on the abdomen. Juveniles will not cling to their mother's abdomen once these hairs have been shaved.

Since the *Chyzeria hirsti* there is an unusual behaviour pattern in the larvae and an unusual structural modification of an area of the adult, where the unusual larval behaviour is manifested, it would be reasonable to interpret the adult structure as possibly subserving the larval-adult behavioural modes. Although in larval *Chyzeria* the anterior and posterior (neolateral) pedotarsal claws are provided terminally with a 'suction' membrane, this adaptation cannot necessarily be considered as related to the adult-larva behaviour, but could possibly serve some other function, such as ensuring adhesion to a thick-skinned host.

It is also reasonable to speculate that the fine convoluted hairs of the adult allow utilization by the larva in its rather jerky mode of progression over the idiosoma. The convoluted hairs appear to be of uniform thickness and unciliated, even when viewed either by phase-contrast or polarized-light microscopy. The shaft (scobillum) outer layer is birefringent, as is usual for any trombidiform normal-type seta (scobala) (see Southcott 1961b, 1963a for details of seta terminology). The undulations or coils (and the terminal hook) on these hairs could serve the same function as e.g. special knobs (as is the case in the lycosid spiders mentioned above) i.e. allowing the larvae better to utilize them in walking or moving across the adult's back. For these setae the name *sericala* is proposed.

These setae are present in both *Chyzeria austral-*

iensis and *C. hirsti*. They are present in some other species of Australian *Chyzeria* with various specific determinations by Womersley, in the South Australian Museum collection. These include specimens from Tasmania, Victoria (but not all) and Queensland. They are not present in three specimens in the collection identified as *C. musgravei* Hirst by Womersley. (I have not seen the type of *C. musgravei*.). These three specimens instead possess in the central dorsal idiosomal space a number of stiff sword-like setae, arising from small plaques (seta-bases), as well as longer, flexible, ciliated setae, arising similarly.

Details of these three specimens are as follows:

(1) ACB715. One specimen. Top of Carrington Drive, Nat[ional] P[ar]k, N.S.W., 31.x.1944, H. W[omersley].

(2) ACB716. Queensland, 1943. No other data.

(3) ACB717 (Two slides) One specimen. In leaf debris, Brookfield Rd., nr Haven Rd. Brookfield, 5.iv.1961. E. H. Derri [c] k [Queensland].

Other Possible Phoretic Usage of *Chyzeria hirsti* Adult

A further usage of an adult *Chyzeria* as a phoretic host has been observed. In that case an adult female of *Chyzeria hirsti*, collected at Workanda Creek, National Park, Belair, South Australia, on 1 August 1948, was observed to be carrying an adult female pygmephorid mite. For further details, see p. 318, and Fig. 18 in this paper.

NOTES ON THE ADULT OF *Chyzeria hirsti* WOMERSLEY

As stated above, Womersley separated this form as a subspecies in 1934. In his discussion on *Chyzeria australiense* (sic), *C. occidentalis* Hirst, 1929 and *C. musgravei* Hirst, 1928 Womersley (p. 182) included the following remarks (after reducing *C. occidentalis* to a 'variety' of *C. australiense* (sic) Hirst, 1928) 'Further, Hirst's *C. musgravei* must also be considered as a variety differing in that the anterior median plate (this is an error for 'process' or 'tuberosity'—R.V.S.) is developed into a compartively long process. One specimen amongst the Hirst material in Professor Harvey Johnston's keeping, and now in the South Australian Museum, is clearly intermediate between the two forms in respect of this character, the process being shorter and triangular. This specimen was labelled in pencil by Hirst as *C. musgravei*. All the specimens collected recently by Mr M. W. Mules and myself in the Adelaide District agree with this intermediate form, for which the name *C. australiense* var. *hirsti* var. nov. is proposed.

'Loc. Type: Willunga, West. Aust.; paratypes: Woodside, S. Aust., July, 1933 (W.M.); Mt Osmond, S. Aust., Sept. 17, 1933 (H.W.); Glen Osmond, S. Aust., Oct. 1, 1933 (H.W.)'.

Womersley also provided (pp. 183-4) a key to the Australian and New Zealand species of *Chyzeria* in which the above differences were restated in separating *C. australiense* (sic) var. *musgravei* from *C. australiense* (sic) var. *hirsti*. The New Zealand species *C. novaezealandiae* Hirst, 1924 was misnamed as *C. novae-hollandiae* Hirst by Womersley, who was then comparatively unfamiliar with the Australian fauna and history.

Although the characters proposed by Womersley (1934) in the separation of this taxon as a subspecies, and presented by him in the text and the key to the species, appear comparatively slight, the present author believes that *hirsti* is worthy of full specific rank and therefore formally raises it to species status now. Again, although this paper does not aim to deal with the classification of the adult *Chyzeria*, some redescription of adult *Chyzeria hirsti* and comparison with *Chyzeria australiensis* Hirst are required.

DESCRIPTION OF THE HOLOTYPE ADULT OF *Chyzeria hirsti* WOMERSLEY, 1934 (FIGS. 3; 4 A-D)

The specimen (identification ACB718) is slide-mounted in clear unstained medium, cleared, decolorized, squashed and disrupted, possibly partly dissected, so that it is difficult to give other than imprecise details of the soft parts. Scattered around the mounted specimen are a number of eggs and skins, without evidence of contained embryos (at least there is no evidence of internal chitinization). The disruption of the animal on the slide is such that it is almost divided into two parts by a line of tearing behind the coxae II, and there is a further oblique tear in the opisthosoma (Fig. 3).

Mite appears to be of normal *Chyzeria* shape and characteristics, with moderately strong legs and gnathosoma, and a somewhat elongate idiosoma with the usual processes. Legs I and IV are about equal in length to the idiosoma, with legs II and III somewhat shorter.

Length of animal on slide from tip of chelicera to tip of posterior idiosomal processes 2900 μm. (The length in life is estimated from the degree of damage to the specimen as about two-thirds of this figure, i.e. ca 1900-2000 μm. Length of idiosoma in the mount 1950 μm, width (at widest part, including edges of dorsal processes) 900 μm.

Eyes 2 + 2, sessile, anterior eye 42 μm across, posterior eye larger, 56 μm across, rather more medial; the two eyes making a conjoined mass 116 μm by 57 μm. In the mid-line, somewhat anterior to the eyes, is a pair of prominent tubercles, each about 46 μm across and high. From each of these sensilla a fine sensillary hair emerges, about 240 μm long. Between the eye masses and the sensillary tubercles is the "sensillary area", which bears about 20 long cilated setae. A few similar setae arise also along the

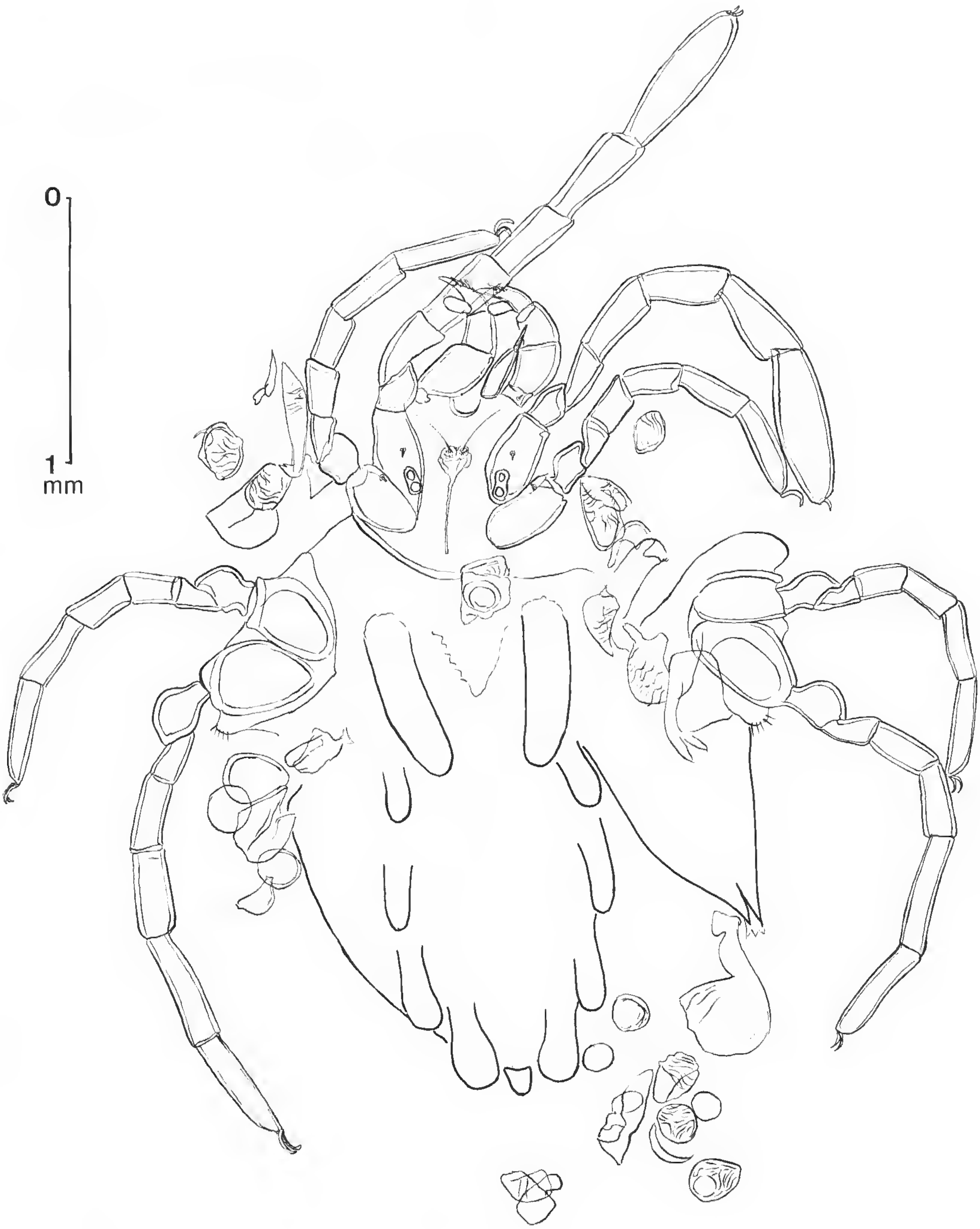

FIG. 3. *Chyzeria hirsti* Womersley, adult. Holotype female, specimen ACB718, shown in transparency (genitalia and anus omitted). The body and leg setae are mostly omitted. The specimen has been ruptured in the mounting process, and ova of various sizes have been released.

medial edges of each eye mass. There is a weak indication of a crista running posteriorly from the sensillary area for about 360 μm; this is thin and has an irregular margin, becoming vaguer and weaker posteriorad.

Dorsum of the idiosoma with the characteristic digitations or projections of the genus. The anteromedian is rather conical, but not well-defined. These projections are all studded with little bosses carrying the setal plates. They carry two kinds of setae (scobalae), the more prominent kind being the stiff spine-like unciliated setae, which project out like spines of a hedgehog, and range from 86-260 μm long. Among the spine-like scobalae are a number of more normal, slender, cilated setae, which project out beyond the spine-like setae. The anterolateral and posterolateral processes are long, more or less round-ended and hence sausage-shaped. In between them are less prominent projections, so that along each side of the dorsum of the idiosoma is a column of five more or less distinct projections. The second and third processes project the least, but are still distinct. The two most posterior projections are bulbous. There appears also to be a posteromedial projection, probably somewhat ventrally placed, but as in the specimen it is detached and displaced away from the idiosoma between the two most posterior projections, its exact placing is not determinable in this specimen.

In the central area of the dorsum of the idiosoma is a large number of long fine convoluted hairs, each rising from an expanded seta-base, forming a small plate. These setae are simple, terminally pointed, but so heavily convoluted that it is difficult to estimate their length; the degree of convolution also tends to give a false estimate of their numbers. (See Fig. 4C). Among them are a few of the long spine-like setae.

Venter of idiosoma is provided with numerous short ciliated hairs, without any spine-like or sword-like setae. Genital valves appear normal, with the usual 3 + 3 oval or circular 'suckers'; the degree of disruption of the specimen precludes further detail being given.

Legs fairly robust (see Fig. 3); lengths (trochanter proximally to tip of tarsus, without claws) I 2 000 μm, II 1 405, III 1 465, IV 1 905. Tarsal claws appear normal. For leg segmental measurements see Table 5 (below).

Gnathosoma as figured. Chelicerae appear normal, but not visible in lateral view, as the right chelicera is at least partly missing (?dissected away). Palp robust. Palpal tibial claw strong, with a strong accessory claw immediately behind it, reaching to about ⅔ its length; another accessory claw behind that also. These two accessory claws are the most distal members of a comb of about 12 spines along the lateral face of the palpal tibia. Similar spines are spread over the lateral face of the palpal tibia, without any regularity of arrangement. (Note: the customary term spine is used here, although these projections are not true spines, but are highly modified normal-type setae, i.e. scobalae.) Palpal tarsus ovoid, shorter than the tibial claw, well-covered with setae, these being longest peripherally, so that these setae extend to reach the level of the tip of the palptibia.

The eggs on the slide are round to oval, or ruptured. The size is quite variable, ranging from about 380 μm x 345 μm, down to 120 μm x 120 μm; an average dimension is perhaps 240 μm x 185 μm.

SITE OF ORIGIN OF THE TYPE OF *C. hirsti*

Some clarification is required of the details of the origin of the specimen.

The specimen of an adult in the South Australian Museum collection is labelled TYPE in red ink in Womersley's writing. Other data on the sole slide label are 'Woodside. S.A. July, 1933 M. W. Mules'. The determination of Womersley's on the label is '*Chyzeria australiense* Hirst v. *hirsti* n. v.' I have added 'ACB718'.

Womersley (1934, p. 182) stated that the Type came from 'Willunga, West. Aust.', and lists the Woodside specimen among the paratypes. This is clearly an error by Womersley, as the slide of the Woodside specimen is clearly and unequivocally labelled, and the four slides containing material from 'Willunga, W. A.' have no marking indicating that they were ever considered as type material. The four Willunga slides represent only one specimen, which Womersley had partially dissected. I have labelled these four slides ACB677A-D, for future reference. Although the slides give no date or name of collector on their present labels, which are in Womersley's writing, one slide (A677B, of a palp) has written upon it '(labelled as *C. musgravei* by S. H.', this indicating it was of Hirst's collecting and original identification. No evidence of the original label of Hirst remains. As each slide bears the notation '*Chyzeria australiense* Hirst v. *hirsti* n. v.' (or some abbreviation of this) it is clear that this specimen is to be correctly designated a Paratype.

Slide ACB677D has written upon the label, in Womersley's writing 'Willunga. W. A./ no date/ from Univ. Coll./', indicating that this was one of the specimens deposited by Professor T. Harvey Johnston in the South Australian Museum, from the Department of Zoology, University of Adelaide.

Hirst had worked in the Zoology Department while Professor Johnston was absent in the Antarctic with the British Australian and New Zealand Antarctic

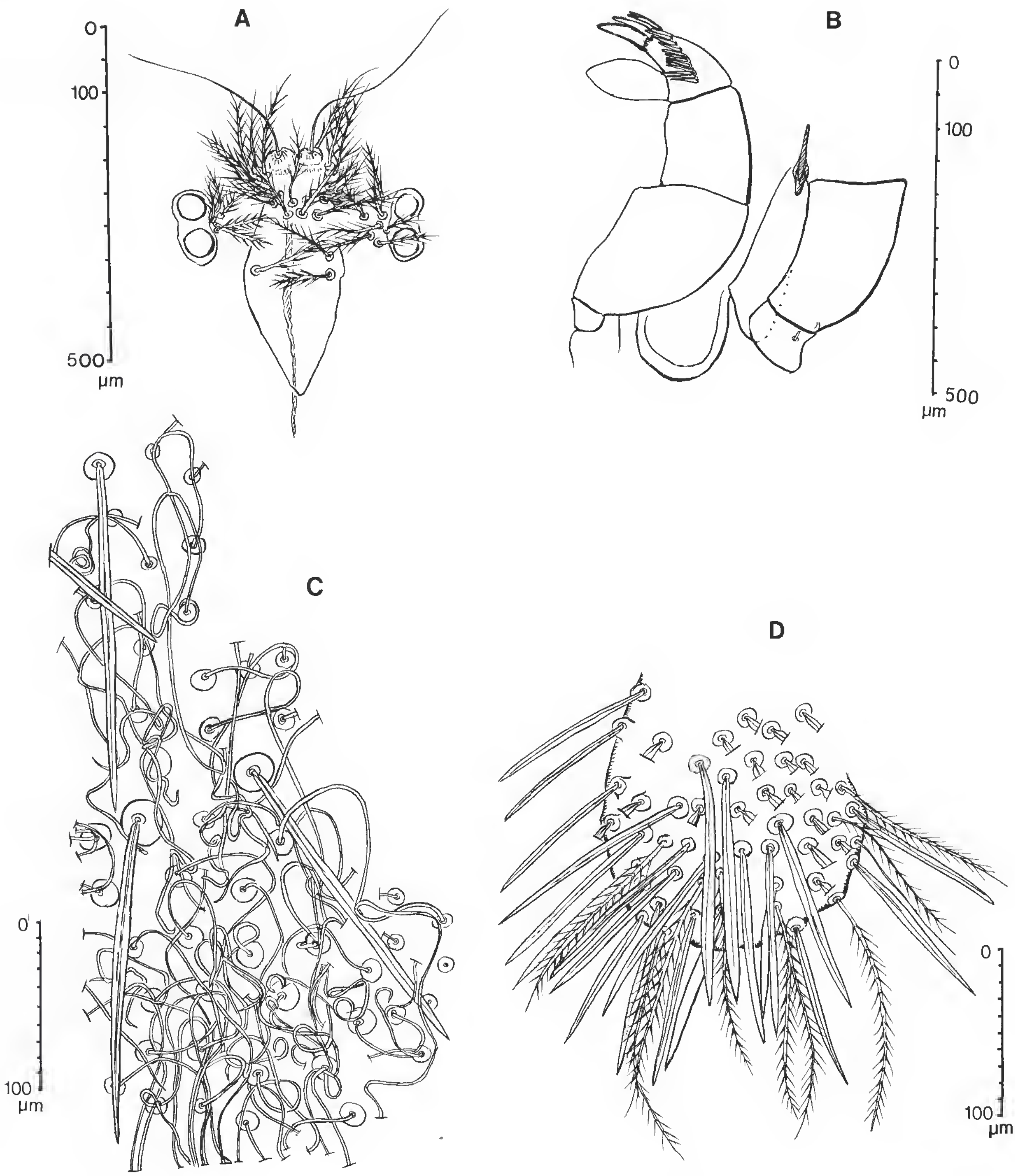

FIG. 4. *Chyzeria hirsti* Womersley, adult. Details of holotype female specimen ACB718. A, Dorsal idiosomal sensilla, eyes and neighbouring structures. B, Left palp, in lateral view, and right chelicera. The left chelicera is missing. The proximal part of the right palp is also shown. C, Setation of the central dorsal part of the idiosoma, showing the fine convoluted sericalae, and a few of the sword-like setae. D, The most posterior of the right lateral column of dorsal idiosomal processes, showing the two types of setae present. (All figures to adjacent scales.).

Expedition of 1929/1931, but unfortunately committed suicide on the return voyage to England. Hirst had collected at various sites in South Australia and eastern Australia, one of his species in fact being named *Microtrombidium willungae* Hirst, 1931* collected by Hirst at Willunga, South Australia, October 1929.

Reference to the Gazeteer of the United States Board on Geographic Names, Number 40 (Australia) shows that the name Willunga occurs only in South Australia, in the forms of Willunga and Willunga Hill, which are in fact contiguous, the former being a township. Both are at 35°17'S lat.; the former at 138°33'E and the latter at 138°34'E long. Womersley arrived in South Australia only in 1933, and at the time was not familiar with South Australian place names (see Southcott, 1963b).

Chyzeria australiense (sic) was described by Hirst in 1928 (1928a, p. 563) from "Swan River, W.A. In nest of *Ponera lutea.*"

In the South Australian Museum collection are four relevant slides labelled as originating from Swan River, W[estern] A[ustralia]. Three of them bear a label in Hirst's writing, while one bears a label by Womersley. These represent the TYPE and a Paratype. I have attached identifying numbers ACB719 and ACB720 to these specimens as follows:

ACB719. Intact specimen mounted in well-slide, labelled in what I interpret as Hirst's writing "*Chyzeria australiense* HIRST/Swan River/W.A./S.A. Mus. Coll./ Nest of *Ponera lutea*"

ACB720. A series of three slides, to which I have attached the identifying numbers ACB720A, B and C, as follows:

ACB720A: Heavily dissected specimen, mounted in well-slide, labelled in same writing as preceding "*Chyzeria australiense* HIRST/Swan River/W.A./S.A. Mus. Coll./Palp", the term "Palp" being crossed out in pencil.

ACB720B: Slide containing the end of a first leg of a trombidiid mite, of three segments, labelled as for preceding slide, but with "1st Leg" replacing the term "Palp". Reference to slide ACB720A shows that three segments are missing from the left first leg.

ACB720C: Slide bearing a label in Womersley's writing "*Chyzeria australiense* Hirst/Palp/ in nest of *Ponera lutea* / Swan Riv. W.A./S.A.M. coll." and has also the word "TYPE" written on it in red ink, in Womersley's writing. This palp appears to have been the source of Womersley's (1934) Fig. 2.

There is no doubt that specimen ACB719 is the Holotype of *Chyzeria australiensis* Hirst, from the red slide notation of "Type", in a writing that does not appear to have been Womersley's, and is presumably Hirst's. I have attached an additional label to the slide, identifying it as ACB719, and with the word "TYPE". This specimen was not figured by Hirst, but was apparently the source of Womersley's (1934) Fig. 1. (The specimen has the palpi flexed, and not extended as figured by Womersley. Otherwise, however, there appears to be a general agreement with the figure.)

The three slides I have labelled ACB720 appear to make up a single specimen, and I have labelled these ACB720A, B and C with additional slide labels, and have added to each the word "PARATYPE". I regard Womersley's use of the word "TYPE" on slide ACB720C as either frankly erroneous, or as a loose indication that the specimen belonged to the type series. I do not know whether there were originally two slides and a further mount was made by Womersley, or whether there were originally three, the label of one being discarded by Womersley in 1933-4.

SOME FURTHER DATA AND COMPARISONS FOR ADULTS OF *Chyzeria hirsti* WOMERSLEY AND *Chyzeria australiensis* HIRST.

Table 5 gives various measurements for the holotypes of *Chyzeria hirsti* Womersley and *Chyzeria australiensis* Hirst, as well as for some other specimens of each of these species.

* Now *Etmuelleria willungae* (Hirst); see Southcott 1957a, p. 142.

Table 5. Measurements (μm) for some adults of *Chyzeria hirsti* Wom. and *C. australiensis* Hirst, including lengths of nominated leg segments and their ratios, also the lengths of the posterior dorsal swordlike setae.

	Chyzeria hirsti								*Chyzeria australiensis*							
Specimen	Holotype ♀ ACB718 Woodside, S.A.		Paratype ACB677 Willunga, S.A.		ACB13/14A ♀ Glen Os., S. Aust.		ACB13/14B Glen Os., S. Aust		Holotype ACB719 Swan R., W.A.		Paratype ACB720 Swan R., W.A.		ACB721A Nyabing, W.A. 2.8.45 P.N.F.		ACB721B Nyabing, W.A. 2.8.45 P.N.F.	
	Length	Ratio	Length	Ratio	Length	Ratio	Length	Ratio	Length	Ratio	Length	Ratio	Length	Ratio	Length	Ratio
Segment																
Ta I	605	1.00	583	1.00	572	1.00	562	1.00	482	1.00	482	1.00	580	1.00	576	1.00
Ti I	382	.63	367	.63	396	.69	396	.70	360	.75	396	.82	418	.72	396	.69
Ge I	331	.55	324	.56	346	.60	342	.61	310	.64	313	.65	335	.58	353	.61
Ta II	374	1.00	346	1.00	374	1.00	346	1.00	346	1.00	342	1.00	382	1.00	367	1.00
Ti II	295	.79	259	.75	288	.77	295	.85	288	.83	288	.84	335	.88	324	.88
Ta III	403	1.00	346	1.00	360	1.00	367	1.00	353	1.00	363	1.00	382	1.00	385	1.00
Ti III	317	.79	288	.83	317	.88	317	.86	328	.93	302	.83	367	.96	382	.99
Ta IV	446	1.00	410	1.00	446	1.00	—*	—	389	1.00	389	1.00	432	1.00	439	1.00
Ti IV	468	1.05	400	.98	482	1.08	ca480*	—	482	1.24	493	1.27	562	1.30	522	1.19
Posterior dorsal swordlike setae	80-204		88-172		120-195		144-172		86-135		80-143		72-152		86-138	

* Somewhat obscured in the mount, and cannot be measured accurately

Perusal of Table 5 suggests that some of the dimensions could be useful in separating the two species *australiensis* and *hirsti*. Of them, the range of the lengths of the posterior dorsal swordlike setae is the most useful as the ranges differ considerably, with their maxima ranging from 172-204 μm for *hirsti* and 135-152 μm for *australiensis*.

Chyzeria onychia (Womersley)

(Figs. 5, 6, 7A-B, 8A-G, 9)

Synonymy

Grossia onychia Womersley, 1954 (1954a) p. 111; Audy, 1954, p. 166; Audy 1957 p. 442; Vercammen-Grandjean 1972 p. 231.

Redescription of Holotype

Colour in life not recorded by collector G. F. Gross or by Womersley. Slide-mounted specimen (it has not been remounted by either Vercammen-Grandjean or myself) has the idiosoma ca 1750 μm long by ca 1600 μm wide; total length of animal from tip of chelicerae to posterior pole of idiosoma ca 1900 μm. (The specimen has been severely compressed on the slide and ruptured on mounting, hence these measurements are likely to be significantly larger than the measurements in life.)

The standard (and some other) data of the Holotype are as follows (and compared with data published by Womersley and Vercammen-Grandjean):

	This paper	Womersley (1954)	Vercammen-Grandjean (1972)
AW	96	100.0	97
PW	151	156.0	149
SB	67	73.0	65
ASBa	44	143.0(!)	42
PSB	44	20.0(!)	42
L	88	163.0(!)	84
W	167	—	—
A-P	52, 52	55.0	50
AL	112	112.0	110
PL	83	84.0	88
Sens	ca180	168.0	162
DS	103-173	163	102-174
mid-DS	110-138	—	—
PDS	112-138	—	—

Scutalae tapering, somewhat sinuous in the mount, slightly blunted at tip, with weak, barbed, almost adpressed ciliations.

Eyes 2 + 2, sessile, conjoined, the eye patch placed well laterally to the dorsal shield, eyes of about the same size, anterior more medial, circular, 16 μm across, posterior oval, 15 μm × 17 μm.

Dorsal idiosomalae similar to scutalae, tapering, slightly blunted at tip, with weak, barbed cilia; cilia only a little outstanding from shaft. Dorsal idiosomalae have their seta bases expanded to small plates (see Fig. 8C, D).

Venter: no setae between coxae I, II and III. Behind coxae III are a small number of opisthosomal ventralae, arranged as figured. (The pattern that exists is not clear on account of damage that has been done to the specimen in mounting.) The setae are tapering, pointed, somewhat (more or less adpressedly) ciliated, 40-77 μm long, the more posterior setae the longer (these remarks excluding the most posterior setae of the mount, whose dorsal:ventral relationship cannot be determined from the mount).

Anal region: anus consists of two hinged valves or plates, each 61 μm long by 20 μm wide, hinged ante-

FIG. 5. *Chyzeria onychia* (Womersley). Holotype larva, dorsal view, to scale on left. The specimen has been distorted and ruptured by the mounting process. The anus and surrounding setae cannot be clearly identified as dorsal or ventral in the mount, hence these are repeated in Fig. 6.

riorly and posteriorly to make a structure 44 μm across in the mount. Each anal plate carries two stiff normal setae, almost straight, tapering, slightly blunted; anterior seta 40 μm long, posterior 64 μm. Surrounding the anus is a group of setae similar to last, pointed or slightly blunted. These opisthosomal setae arise from small expanded plates. (The setation over the posterior end of the idiosoma is contiguous between the dorsum and venter, but in the mount its exact position on the idiosoma cannot be determined).

Coxalae 2, 1, 1. Coxalae robust, tapering, somewhat spindle-shaped, curved, with a few adpressed cilia. All coxalae appear to be similar, but in the specimen only the left coxala III is intact, the others being apparently broken, or missing. Coxala III 38 μm long, terminally tapering to a fine point.

Legs as figured; I 560 μm long, II 565 μm long, III 635 μm (from medial point of each coxa to tip of claws). Femoral to tibial segments roughly cylindrical. Tarsus I 129 μm long by 48 μm high, tibia I 92 μm long, genu I 80 μm (TiI/GeI = 1.15). Tarsus III 129 μm long by 34 μm high, tibia III 109 μm long, genu III 85 μm (TiIII/GeIII = 1.29). (Tarsal measurements exclude claws and pedicle.)

Genu I has specialized seta VsGeI.74pd. Tibia I has specialized setae SoTiI.27d, VsTiI.91pd, SoTiI.92d. Genu II has specialized seta VsGeII.71pd. Tibia II has specialized setae SoTiII.23d and SoTiII.83pd. Tibia III has specialized seta SoTiIII.18d.

Tarsal setae as figured. Tarsal pedicles appear normal. Each tarsus is provided with three claws. The middle (neomedian) claw is normal, strong, falciform. Anterior claw reduced to a slender tapering sinuous rod, with a spreading terminal adhesive membrane. Posterior claw is somewhat more robust than the anterior, and straighter; it terminates in a smaller adhesive sucker set an angle to the preceding claw-shaft.

Gnathosoma short, robust. Chelae bases 96 μm long by 48 μm across individually, the two combined being 96 μm across. Chelae blades short, projecting 32 μm beyond the end of the chelae bases. Chelae bases more or less pyriform. Blade with small scattered retrorse teeth on all surfaces, but stronger laterally. Galeala not identified. Anterior hypostomala tapering, pointed with a few adpressed cilia, 45 μm long. Posterior hypostomala similar, 57 μm long.

Palpal formula 0, 1, 1, 3, 9. Palpal femorala robust, tapering, with strong barbs, 74 μm long. Palpal genuala strong, tapering, pointed, terminally filiform, with barbed cilia, 70 μm long. Palpal tibial claw trifid, the three tines tapering, strong, divergent, slightly blunted. Additionally the palpal tibia carries a strong sickle-shaped accessory seta, with a tapering hook-like end and a small tooth about the middle of its ventral side; this possibly operates in apposition to the tibial claw. Palpal tarsus as figured. Palpal supracoxala present, a slender conical seta 9 μm long.

Locality

The specimen is known only from the Holotype. The collector Dr G. F. Gross, has advised me (pers. comm., 4 August 1975) that he collected it at Tambryn Junction, Otway Ranges, Victoria in January 1951. The specimen, which was parasitic upon an adult *Chyzeria*, was probably brought back alive to Womersley.

No *Chyzeria* adult is among the South Australian Museum slide or spirit collection, with locality data for the Otway Ranges, Victoria.

Remarks on Biology

Observations upon a phoretic relationship between *Chyzeria hirsti* and its larvae have been recorded earlier in this paper. When *C. hirsti* larvae were reared in the laboratory, all larvae were small and clearly unfed. In the case of *C. onychia* , the larva is considerably enlarged, and in fact, judging by other experiences of the author with trombidiid larvae, it appears to be at a stage not far away from pupation, even though recorded as attached parasitically. It may seem remarkable that a larva of *Chyzeria* should parasitize an adult of the same genus (and conceivably, of the same species), but among the family Erythraeidae, in some species the larvae will parasitize opportunistically a wide range of hosts including adult erythraeid and anystid mites (see Southcott, 1946 pp. 39, 41).

Remarks on the Generic Status of *Chyzeria onychia* (Wom.)

There does not appear to be any good reason to separate *C. onychia* generically from the other members of the genus *Chyzeria* (the whole of the known larvae) considered in this paper. The body setae are similar to those of other members referred to the genus, and in fact are less aberrant than, e.g., the AL scutalae of *C. hirsti*. The pedocoxalae are in fact the most normal in structure for any of the larvae considered in this paper. The tarsal claws of the legs are also quite similar to those of the other members of the genus. Womersley's erection of *Grossia* appears to have been simply a consequence of his overlooking his earlier (1939) paper, as remarked above.

Chyzeria flindersi sp. nov.

Figs. 10A, B; 11A-D; 12

Description of Larva (from the Holotype specimen ACB674)

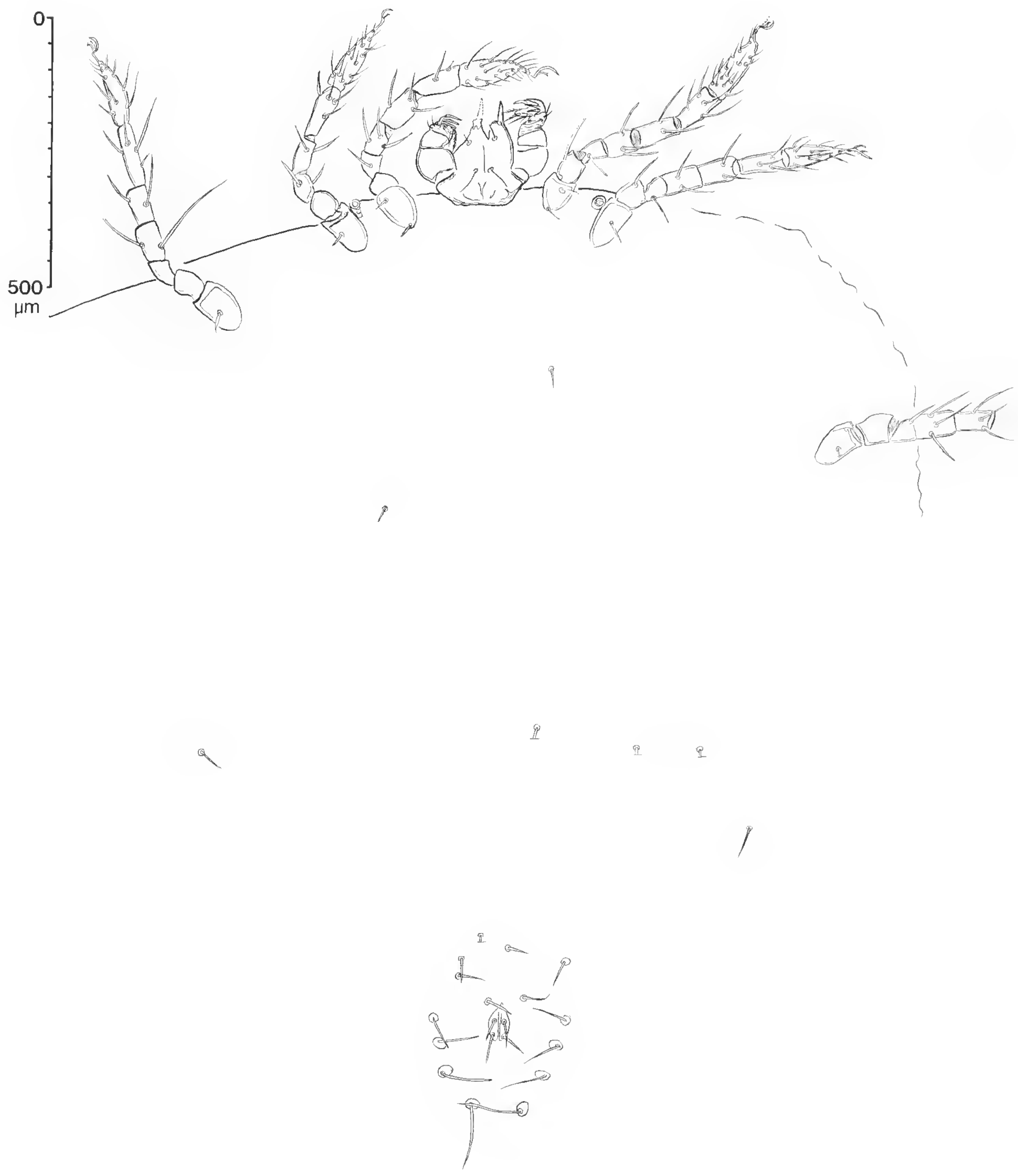

FIG. 6. *Chyzeria onychia* (Womersley). Holotype larva, ventral view, to scale on left. Specimen distorted and ruptured (see also legend to Fig. 5).

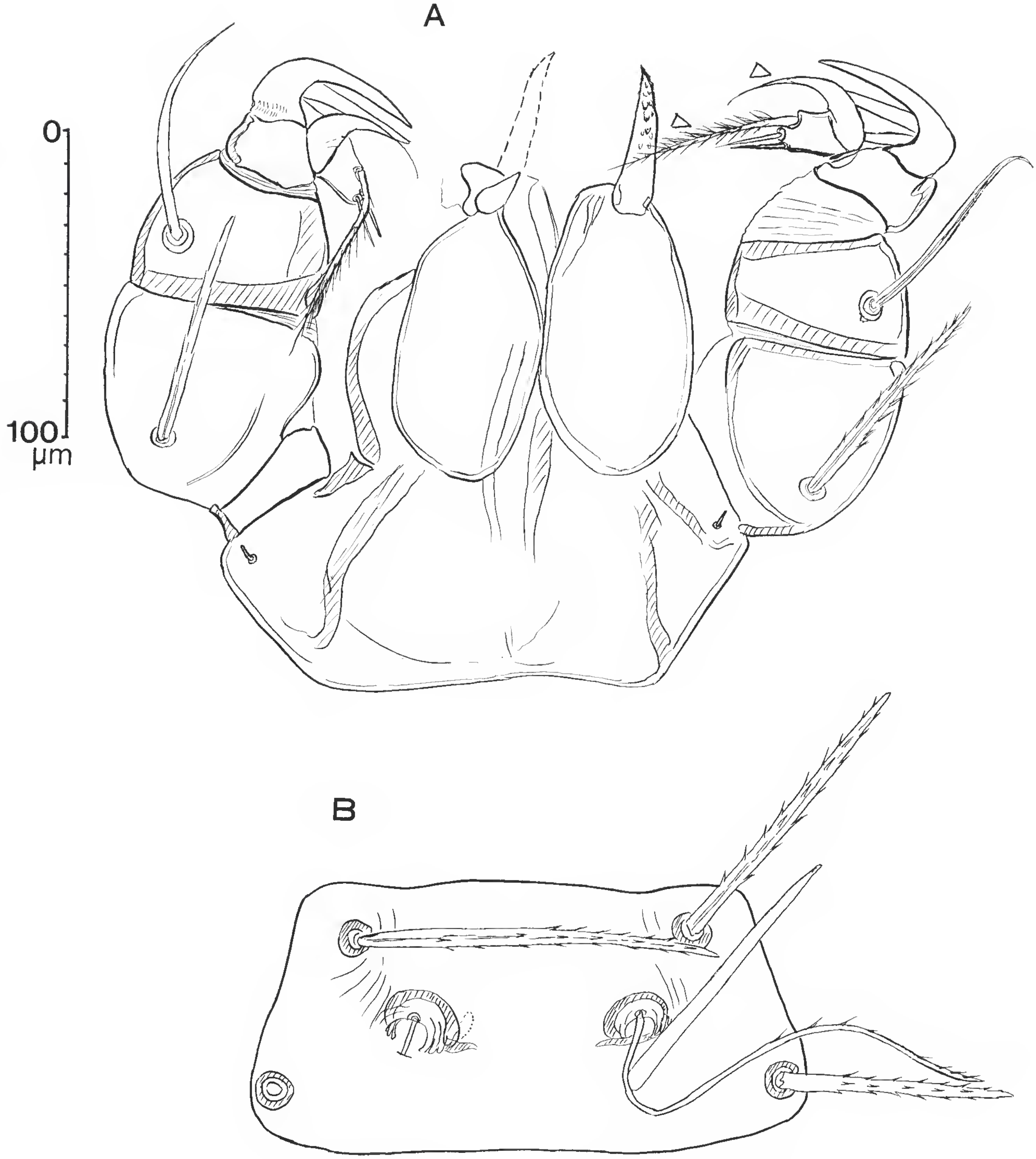

FIG. 7. *Chyzeria onychia* (Womersley). Holotype larva. A, Gnathosoma, dorsal view. B, Dorsal idiosomal scutum. (The right AL scutala has been restored in the figure to its correct position; its position on the slide is shown in outline.) (Both to scale shown).

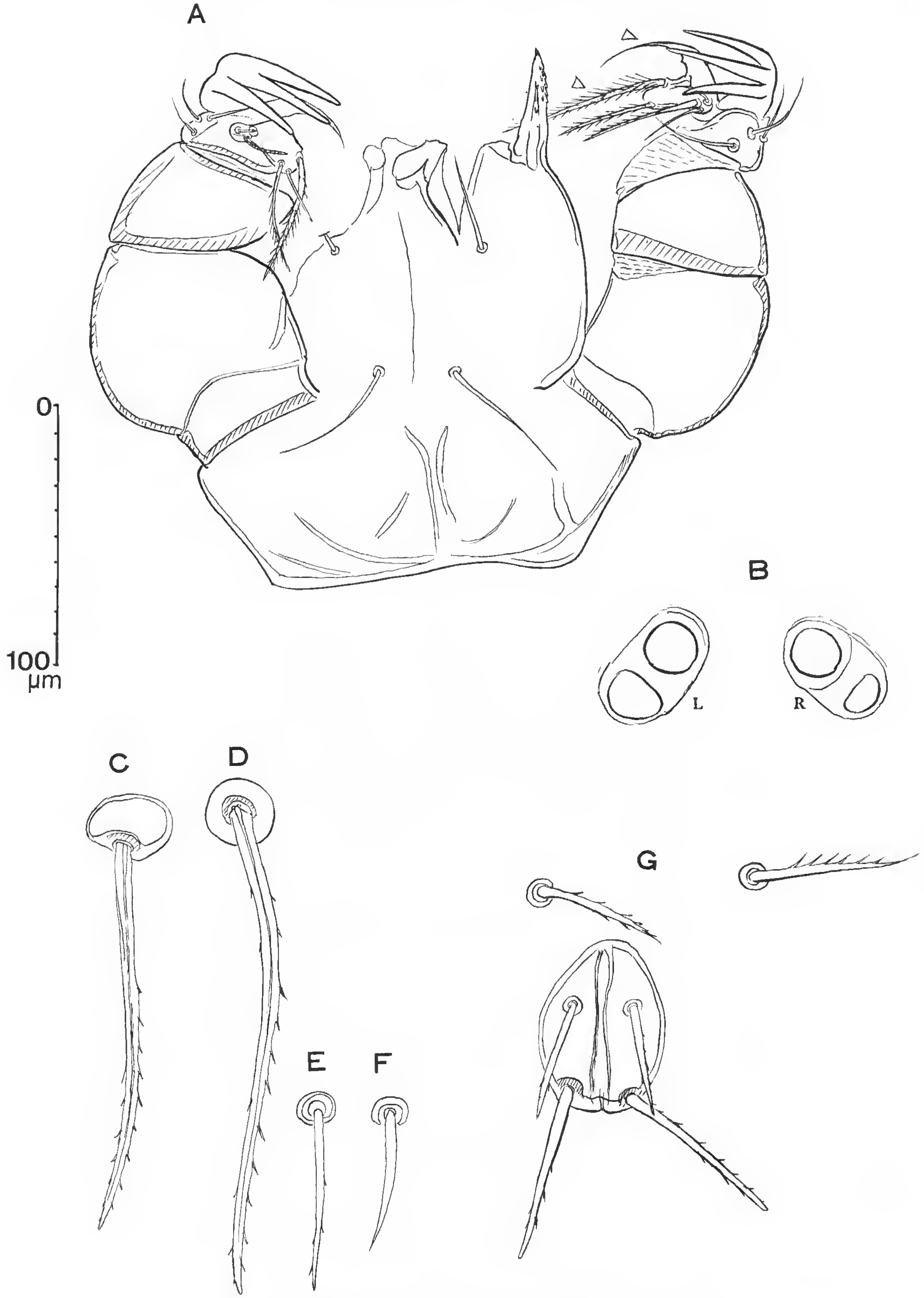

FIG. 8. *Chyzeria onychia* (Womersley). Holotype larva. A, Gnathosoma, ventral view; the chelicera shown on the left is damaged. B, Left eyes and right eyes. C, D, Dorsal idiosomal setae. E, F, Ventral idiosomal setae. G, Anus and surrounding setae. (All to scale shown.).

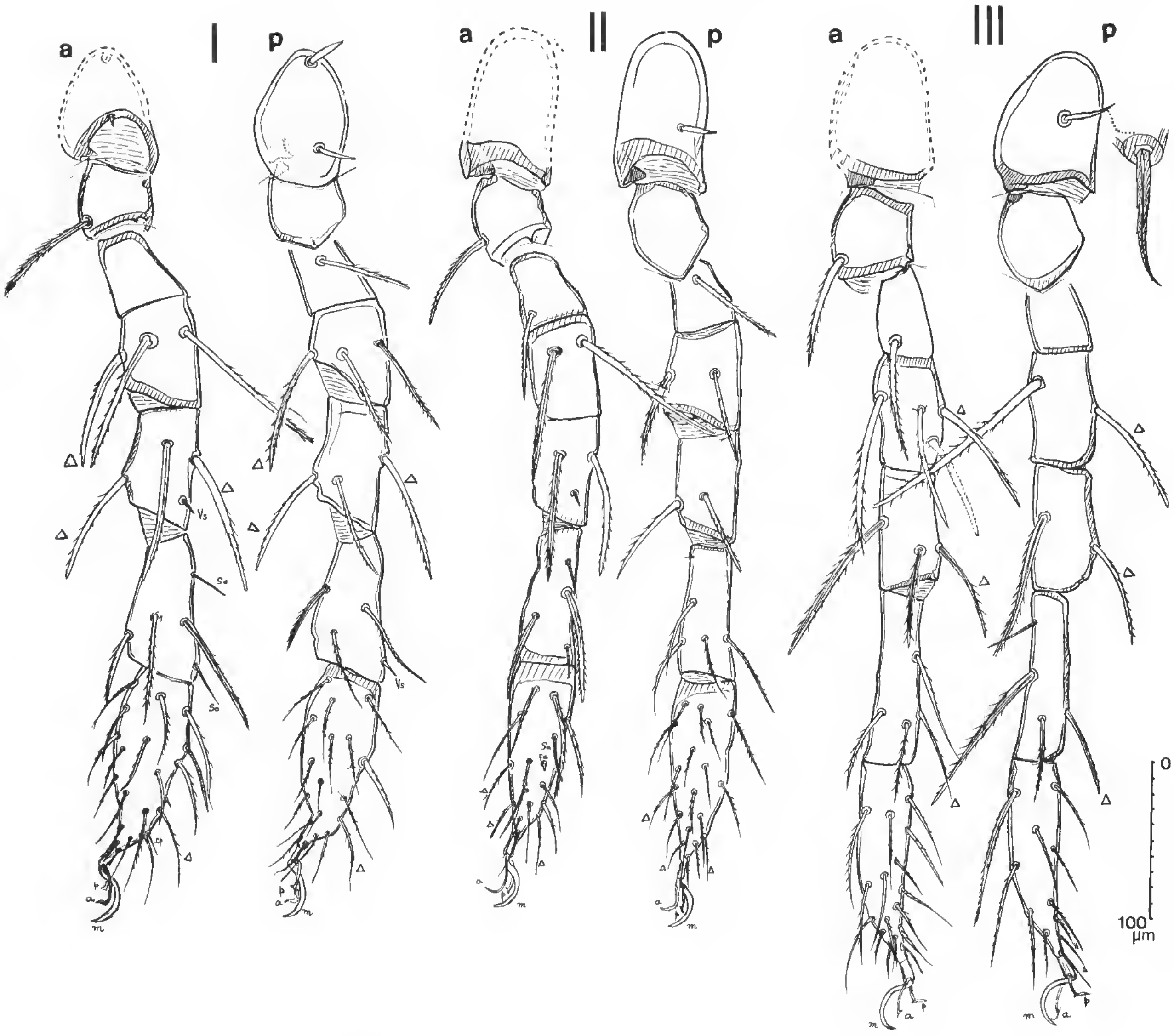

FIG. 9. *Chyzeria onychia* (Womersley). Holotype larva. Legs I, II and III, to scale shown; to standard symbols. (Note: all legs have been dislocated at the trochantero-femoral joints.). Pedocoxala III is also shown, further enlarged.

Colour in life red. Length of idiosoma (mounted on slide) 410μm, width 330 μm; total length of animal from tip of chelicerae to posterior pole of idiosoma 527 μm.

Dorsal scutum as figured; much wider than long, more or less oblong or trapezoidal, with concave anterior and posterior margins, and irregularly convex lateral margins. One pair of scutal sensilla, well separated, placed about halfway between the front and back edges of scutum. AL scutalae at AL angles of shield, PL somewhat anterior to PL angles.

The standard (and some other) data of the Holotype are (μm):

AW	139	A-P	52
PW	184	AL	55
SB	93	PL	52
ASBa	57	Sens	96
ASBp	32	DS	52-77
L	89	Mid-DS	67-71
W	212	PDS	77

Scutalae normal, tapering, ciliated, slightly blunted terminally. Scutal sensillary filaments slender, with a few sparse cilia in distal half.

Eyes 2 + 2, sessile, anterior about 21 μm across, lateral to the posterior part of the lateral edge of scutum; posterior eye close behind anterior eye, 17 μm across.

Dorsal idiosomalae similar to scutalae, but more slender, arranged in rows across dorsum 6, 6, 6, 4, 2, 2; total 26 setae. All dorsal idiosomalae arise from expanded plates.

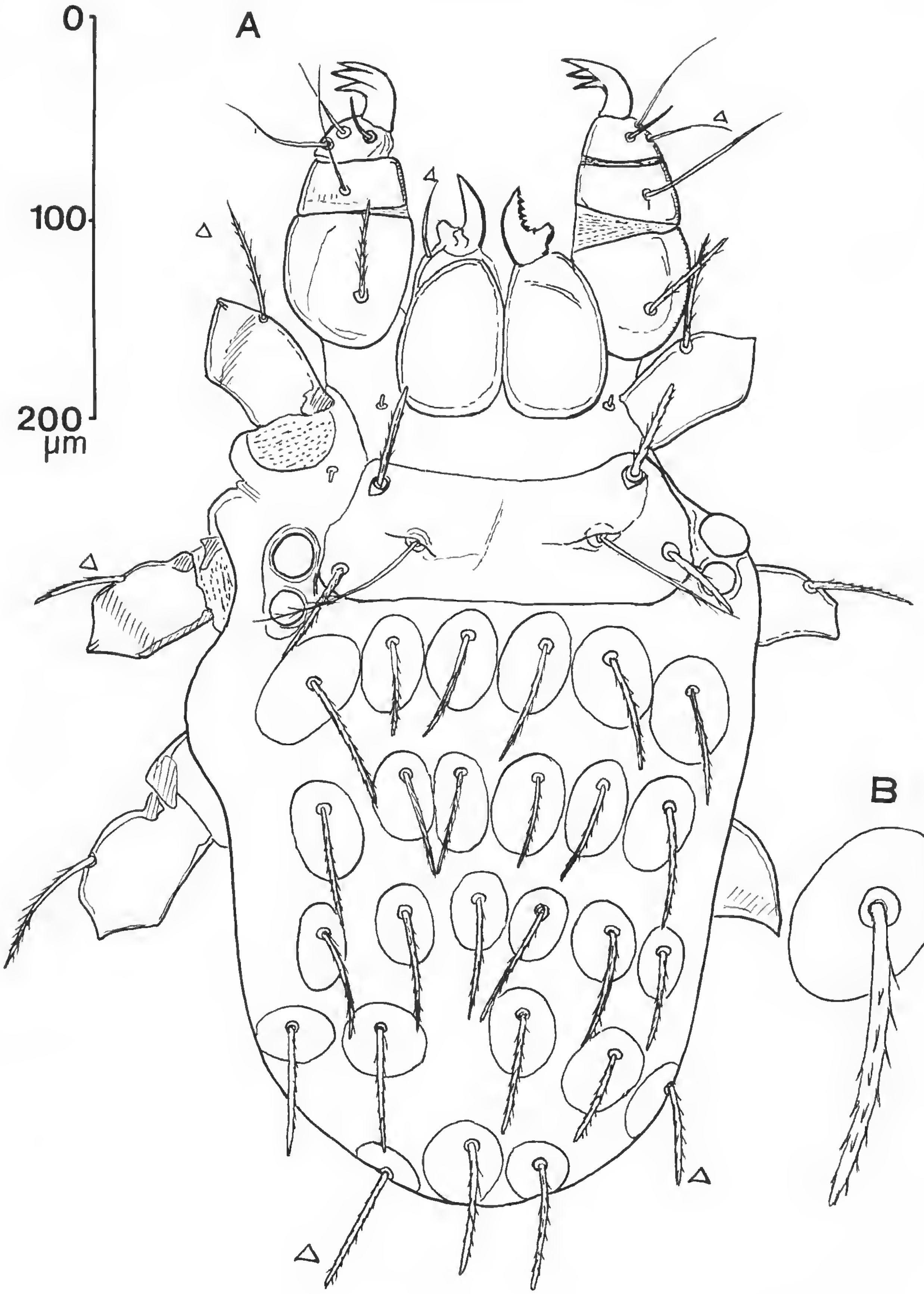

FIG. 10. *Chyzeria flindersi* sp. nov. Holotype larva. A, Dorsal view, to scale on left; legs omitted beyond trochanters. B, Dorsal idiosomal seta, further enlarged.

Venter: no setae between coxae I and II. Between coxae III a pair of setae, with enlarged basal quarter of scobillum, and from this enlarged basal part the distal part arises abruptly, to taper to a smooth point; setae 43, 47 μm long, lacking cilia. Remaining ventralae arise well behind coxae III, about 39 in number, and are 30-54 μm long; they increase in length posteriad. The more anterior setae are similar to the pair between coxae III, except that they carry cilia, these becoming stronger and more outstanding posteriad. The most posterior ventralae tend to resemble the adjoining dorsal setae.

Anal region not clearly visible in Holotype, but appears normal. Anus about 47 μm long.

Coxalae 2, 1, 1. All coxalae stout, blunted, with a terminal slight grooving which makes them appear like small plums projecting from the coxae, 15-17 μm long. Careful microscopy at high power shows an appearance of distal tuberosities (see Fig. 11C).

Legs normal: I 700 μm long, II 655 μm, III 735 μm (all lengths include coxae and claws). Femoral to tibial segments more or less cylindrical. Femora divided. Scobalae normal. Trochanteralae 1, 1, 1, basifemoralae 1 (2), 2 (3), 1, telofemoralae 5, 4, 4. Tarsus I 174 μm long by 50 μm high; tibia I 108 μm long, genu I 94 μ long (TiI/GeI = 1.15). Tarsus III 176 μm long by 40 μm across; tibia III 119μm long genu III 94 μm long (TiIII/GeIII = 1.27). (All tarsal lengths without claws and pedicle.)

Genu I has specialized seta VsGeI.74pd. Tibia I has specialized setae SoTiI.23d, VsTiI.88pd, SoTiI.92d (and hence the distal SoTiI is distal to the VsTiI). Genu II has specialized seta VsGeII.79pd. Tibia II has specialized setae SoTiII.23pd and SoTiII.88pd. Tibia III has specialized seta SoTiIII.26d.

Tarsal setae as figured. Tarsal pedicles short. Pedotarsal claws: anterior curved, slender, two thirds as long as middle claw, with a terminal flattened piece which is more or less at right angles to the claw; middle (neomedian) claw falciform, strong, unciliated; posterior claw curved, slender, shorter than anterior claw, and with a similar flattened transverse piece at the tip (see Fig. 12).

Gnathosoma robust, normal, pear-shaped, chelicera 122 μm long to tip of cheliceral blade, by 108 μm across. Cheliceral blades strong, falciform, 44 μm long. In the Holotype (the only specimen available) the left blade is quite smooth, while the right blade bears ventrally a number of small retrorse adnate teeth; the concave upper surface of the right fang has 7 small teeth, the left fang, none. Galeala spiniform, curved, 33 μm long. Anterior hypostomala short, peg-like, 7 μm long. Posterior hypostomala slender, ca 69 μm long, unciliated.

Palpal formula 0, 1, 1, 3, 9. Palpal femorala tapering, slightly ciliated, very slightly blunted, 52 μm long. Palpal genuala slender, unciliated, 71 μm long. Palpal tibial claw (odontus) with three strong, slightly divergent prongs. Palpal tarsalae as figured. Palpal supracoxala a blunted peg, 8 μm long.

Locality

Tasmania: Lake St. Clair, 28 December 1945, R. V. Southcott. One larva, ACB674, Holotype, running up trunk of *Eucalyptus* sp., at about 1.5 m above ground. The site was in fairly open cleared ground, near the shore of the Lake. Type to be deposited in the South Australian Museum.

Nomenclature

This species is dedicated to Matthew Flinders, R. N., 1774-1814, who was the first to survey the major part of the Tasmanian coastline.

Remarks on Asymmetry in the Chelicerae

In the above description an asymmetry in structure of the cheliceral fangs was recorded, one fang (the presumably normal one) being denticulate, and the other smooth. The present author is unaware of a similar asymmetry of the mouthparts having been recorded previously in at least the Trombidioidea, or Erythraeoidea. Among the Erythraeoidea differences in larval shield setation occur at times; for example, see the discussion on this under the account of *Charletonia venus* Southcott in Southcott (1966, p. 709) and for *Charletonia feideri* Southcott (see *ibid*., Fig. 32, p. 756, and the cases recorded under "Material examined" on pp. 754-8). However, as these setae are presumably responsible for only the sensory input, and some degree of protection, minor abnormalities are unlikely to be a major significance. Major structural abnormalities affecting e.g. locomotory capacity or feeding ability, are more likely to be such a handicap as to threaten survival, and hence are less likely to be encountered in field-collected material.

The specimen was apparently unfed, and whether the asymmetry recorded would be a handicap to feeding is a matter of speculation.

Even among better known animals, major asymmetry in external structures is comparitively rare. Possibly gynandromorphy in insects and heterochromia in mammals are comparable examples. In some groups, notably the fiddler crabs, asymmetry has become part of the genetic inheritance of the group, and is either sex-linked, or hormonally related.

Chyzeria derricki sp. nov.

(Figs. 13A-H, 14A-B, 15)

Description of Larva (from the Holotype Larva ACB633A)

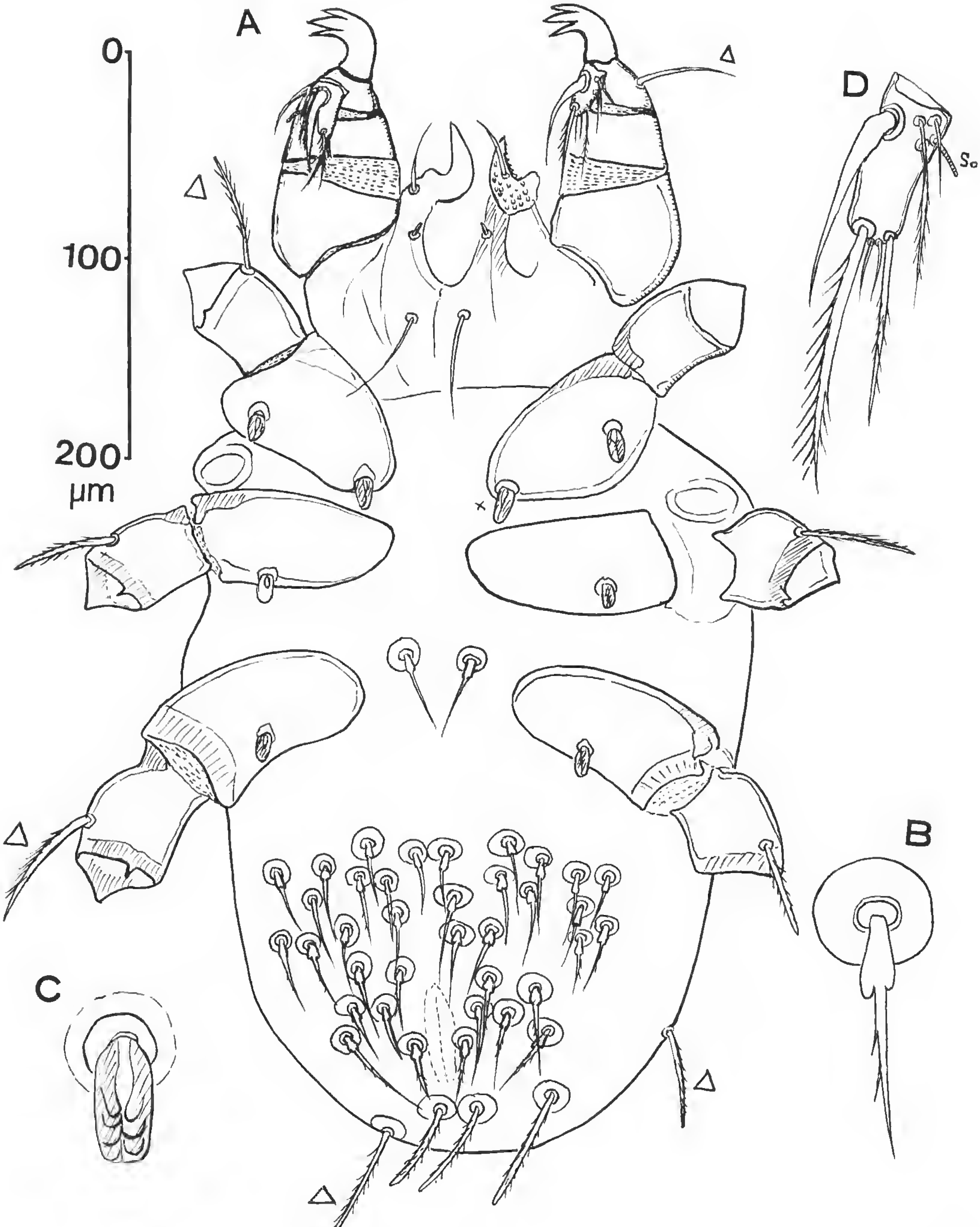

FIG. 11 *Chyzeria flindersi* sp. nov. Holotype larva. A, Ventral view, to scale on left; legs omitted beyond trochanters. B, Ventral opisthosomal seta, further enlarged. C, Pedocoxal seta ('x' in A), further enlarged. D, Palp tarsus, further enlarged.

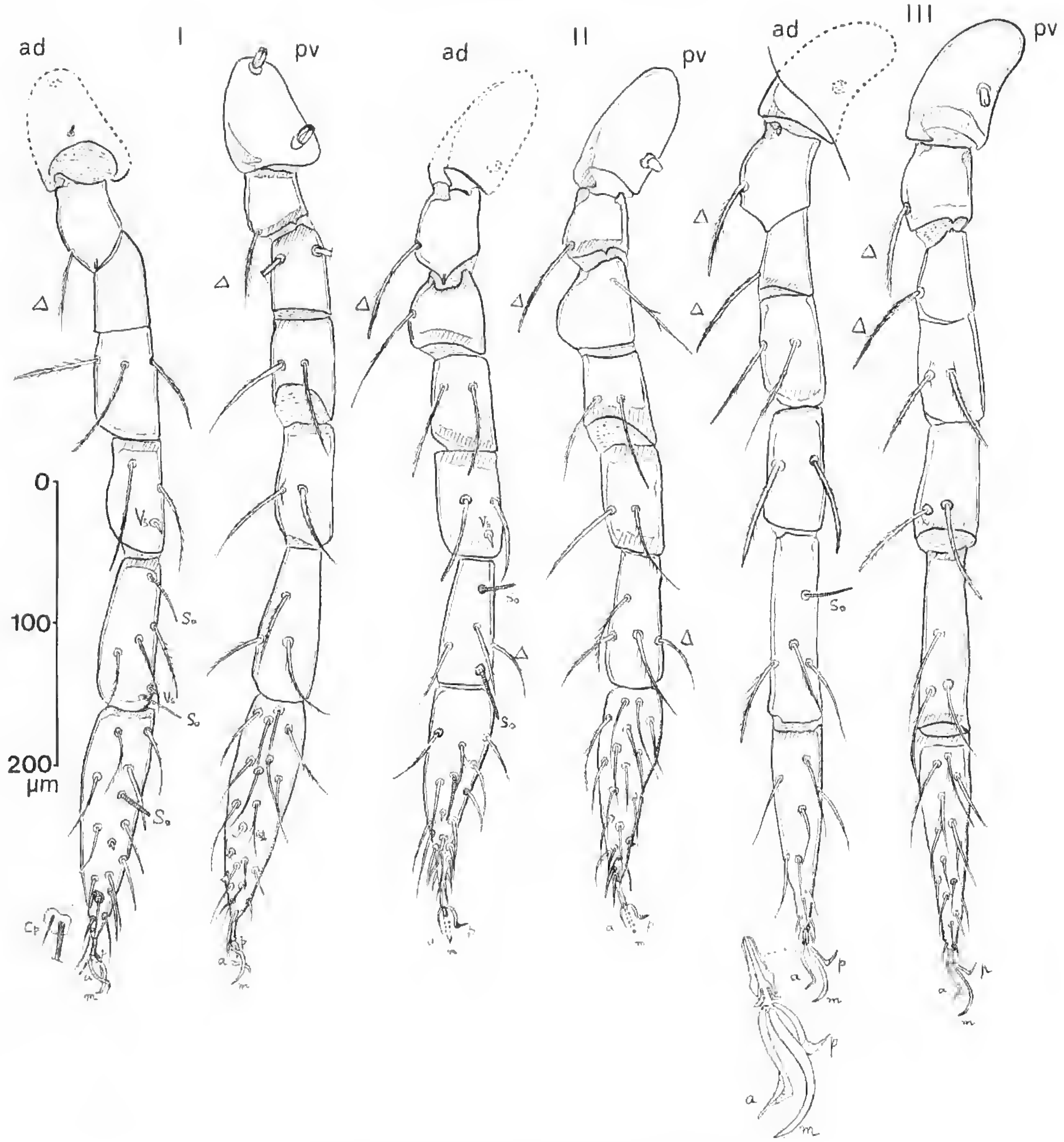

FIG. 12 *Chyzeria flindersi* sp. nov. Holotype larva. Legs I, II and III, to scale on left; to standard symbols.

Colour in life not recorded, presumably red. Length of idiosoma (mounted on slide) 1055 μm, width 610 μm. Idiosoma rather elongate, slightly constricted behind level of coxae III, and somewhat pointed at posterior pole. Total length of animal from tip of galeal seta to posterior pole of idiosoma 1165μm (chelicerae damaged in Holotype, and fangs missing; Paratype ACB 633B lacks gnathosoma, etc.).

Dorsal scutum more or less trapezoidal, with rounded angles, wider posteriorly; anterior and posterior edges slightly sinuous (scutum tends to project a little in the middle posteriorly). Scutum is lightly punctate, particularly in its anterior and more central part, in the area between the sensilla and the AL scutalae. Scutal sensilla normal, the setae with slight, sparse, terminal cilia. Scutalae tapering, pointed, slender, lightly blunted at tip, with adpressed cilia.

The standard (and some other) data of the Holotype (A) and the Paratype (B) are:

	A	B		A	B
AW	102	99	A-P	56, 54	53, 57
PW	152	152	AL	88 (?+)	107
SB	61	61	PL	88	94, 89
ASB	55	55	Sens	153	—

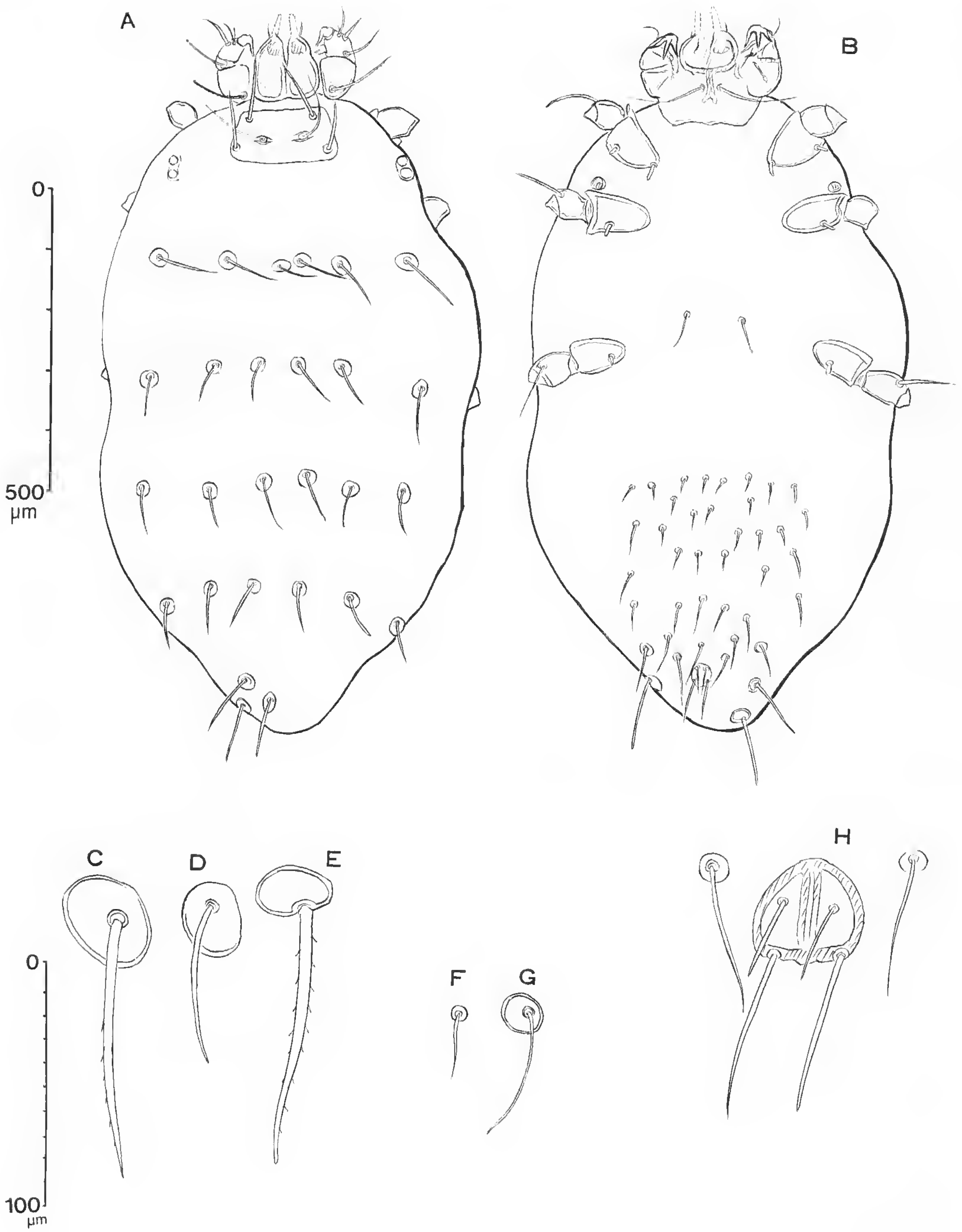

FIG. 13. *Chyzeria derricki* sp. nov. Holotype larva. A, Dorsal aspect, legs omitted beyond trochanters. B, Ventral aspect, legs omitted beyond trochanters. C, D, E, Dorsal idiosomal setae: C, anterior dorsal idiosomala; D, mid-dorsal idiosomala; E, posterior dorsal idiosomala. F, G, ventral idiosomal setae: F, anterior opisthosomala, G more posterior ventral opisthosomala. H, Anal region of venter. (A, B to top scale; C-H to bottom scale.)

	A	B		A	B
PSB	37	39	DS	85-120	74-120
L	92	94	ADS	83-118	77-114
W	178	180	MDS	93-98	74-96
			PDS	85-120	79-120
			PVS	96-114	42-74+

Eyes 2 + 2, sessile, subequal, circular, conjoined, antero-posterior in orientation, lenses 26 μm across.

Dorsal idiosomalae long, tapering, curved, with adpressed cilia, and slightly blunted at the tip; arranged 6, 6, 6, 6, 4, 2. Each seta arises, usually eccentrically, from a small plate, suboval, an expansion of a normal alveolar annulus.

Venter: No setae between coxae I or coxae II. Somewhat anterior to level of coxae III is a pair of tapering, pointed, simple setae, 57 μm long. Behind coxae III is a patch of about 40 similar setae which arise from small plates that increase gradually in size posteriad, with the more posterior setae the longer. The chitinized shaft (scobillum) of the seta also becomes thicker at its proximal end, as one proceeds posteriorad. Anus externally consists of two hinged valves or plates, with a longitudinal opening, the conjoined two making an oval structure 55 μm long by 49 μm wide. Each valve has two setae, tapering, slightly blunted, with adpressed cilia; anterior 48 μm long, posterior 74 μm.

Coxalae 2, 2, 1. All coxalae short, blunted, smooth except for faint distal tubercles (see Figs. 14B, 15). coxalae 15-20 μm long.

Legs comparatively long and thin for a trombidiid larva, compared with body size; tarsi long and terminally attenuated. Leg lengths: I 705 μm, II 655 μm, III 795 μm (all lengths include coxae and claws). Femora divided. Femoral to tibial segments more or less cylindrical. Scobalae of legs tapering, with barbed cilia, and are terminally blunted. Scobalae of telofemora and tibiae tend to be long and particularly outstanding.

Tarsus I 224 μm long by 36 μm high. Tibia I 118 μm long, genu I 112 μm long (TiI/GeI = 1.05). Tarsus III 210 μm long by 24 μm high (at proximal end). Tibia III 141 μm long, genu III 106 μm long (TiIII/GeIII = 1.33). (All tarsal lengths exclude claws and pedicle.)

Genu I with specialized seta VsGeI.82pd. Tibia I with specialized setae SoTiI.10d, SoTiI.91d and VsTiI.92pd. Genu II with specialized seta VsGeII.81pd. Tibia II with specialized setae SoTiII.20d, SoTiII.90d. Genu III without specialized setae. Tibia III with SoTiIII.16d.

Tarsal setae as figured. Pedotarsal claws three in number: anterior slender, falciform with ill-defined terminal spreading suction pad; middle claw falciform, over-reaching others; posterior slender, sinuous, with obliquely placed terminal suction pad.

Gnathosoma short, robust. Conjoined cheliceral bases form a squat pyriform mass 110 μm long (to anteriormost chitinization, except setae) by 105 μm wide. Cheliceral blades missing in Type and Paratype. Galeala normal, pointed, tapering with filiform tip, 32 μm long. Anterior hypostomala not available. Posterior hypostomala long, fine, pointed, simple, about 100 μm long. Palpal setal formula 0, 1, 1, 3, ?9. Palpal femorala tapering, terminally blunted, with outstanding sparse cilia, 123 μm long. Palpal genuala tapering, pointed, unciliated, 96 μm long. Palpal tibialae tapering, pointed. Palpal tibial claw trifid, the three curved tines strongly divergent (see Fig. 14B). Palpal tarsalae as figured, including one relatively huge scythe-like seta, which reaches as far back as the bases of the posterior hypostomalae. Palpal supracoxala short, narrow, pointed, 5 μm long.

Locality

Queensland: Mt Tamborine, 23 February 1954, E. H. Derrick, two specimens taken parasitic upon unidentified tettigoniid grasshopper (identification A294). Holotype ACB633A, Paratype ACB633B (two slides B1 and B2). Specimens forwarded by Dr R. Domrow, Queensland Institute of Medical Research. Type and Paratype to be deposited in South Australian Museum collection. The Paratype has been badly damaged in mounting, and lacks gnathosoma.

Nomenclature

The species is dedicated to the collector, Edward Holbrook Derrick, 1898-1976, medical research worker (see obituary notice in Medical Journal of Australia 6 November 1976).

Remarks on Biology of *Chyzeria derricki*

Parasitization of an insect host is not unusual for a trombidioid larval mite. The only other record of parasitization by a larval *Chyzeria* upon a host is in the case of *C. onychia* (q. v., discussion). The capture of *C. derricki* larva upon a tettigoniid host allows some degree of speculation upon the functional significance of the various morphological adaptations seen in this genus. It is reasonable to suggest, in the case of mites which live as ectoparasites upon mobile insects with wide areas of heavy, smooth chitinization (e.g. Acridoidea and Tettigonioidea), that long legs and development of suction pads upon the tarsi would be useful, as would also strong mouthparts to pierce thickened integuments. On the other hand, it is apparent from a study of at least the erythraeoid mites, that there may be a considerable degree of host specificity, e.g. *Smaris prominens* (Banks) larvae upon

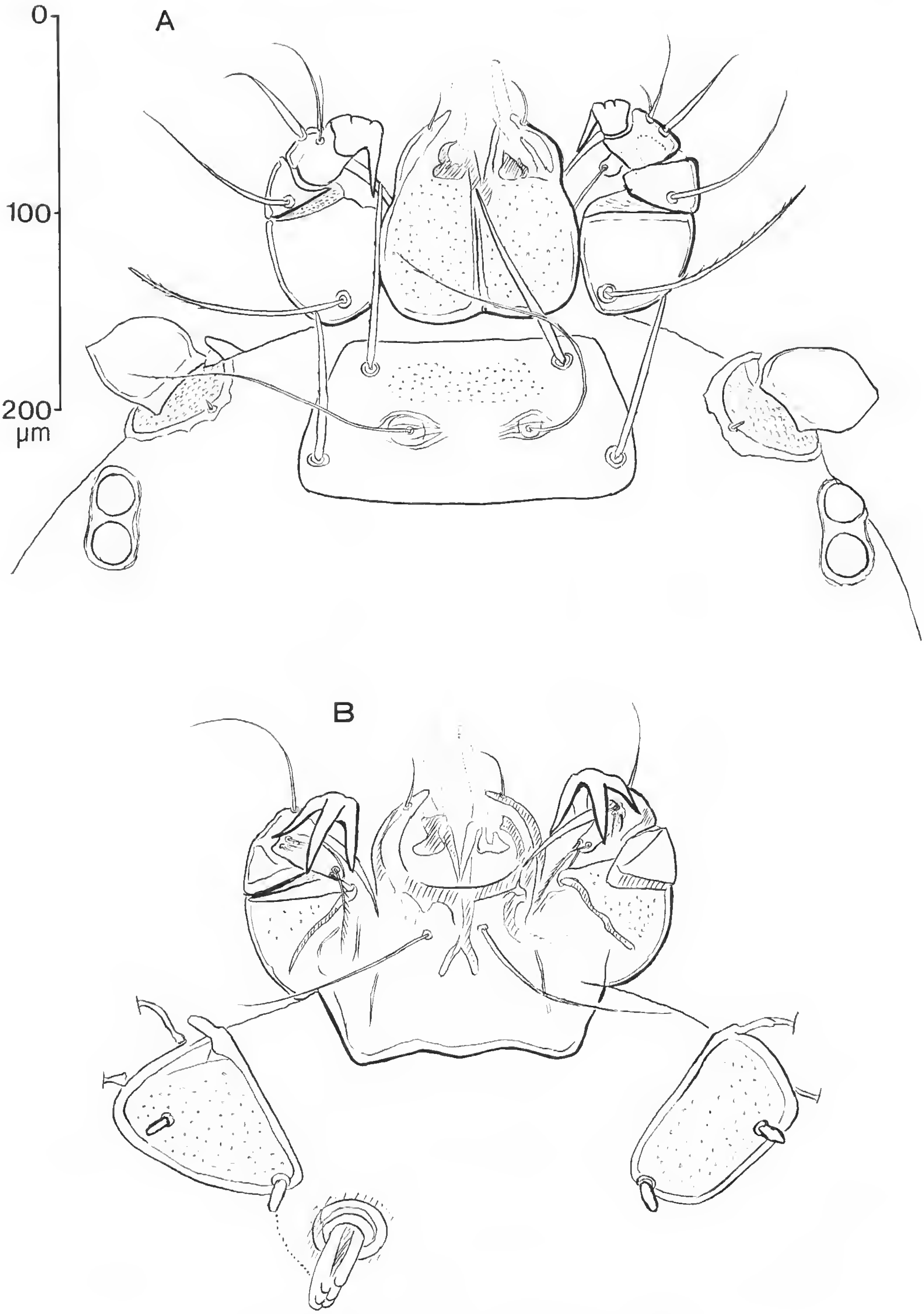

FIG. 14. *Chyzeria derricki* sp. nov. Holotype larva. A, Gnathosoma and adjacent part of idiosoma, and trochanters I, dorsal view. B, Gnathosoma, adjacent idiosoma, with coxae I and part of trochanters I, ventral view. Both to scale shown. In B, a pedocoxala is shown further enlarged.

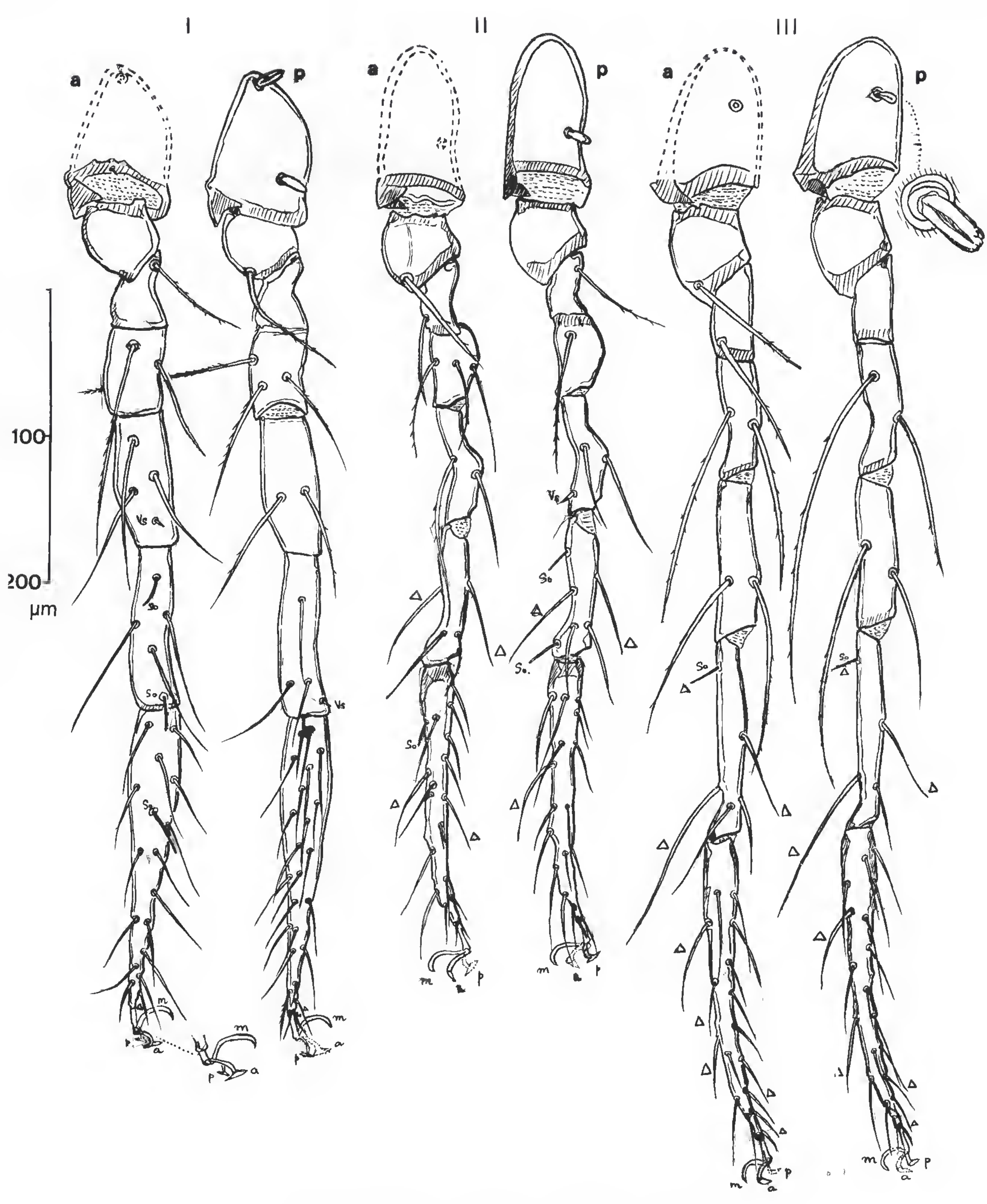

FIG. 15. *Chyzeria derricki* sp. nov. Holotype larva. Legs I, II and III, to standard symbols; to scale shown.

small Psocoptera and *Erythrites osmondensis* (Southcott) larvae upon Thysanoptera. There may also be site specificity upon a host, e.g. *Callidosoma womersleyi* (Southcott) preferring a site under the wings of psyllids, as does also the larva of *Rainbowia imperator* (Hirst, 1928) (Southcott 1961a, p. 477). On the other hand the larvae of other erythraeid mites, *Erythrites reginae* (Hirst, 1928) and *Erythrites urrbrae* (Womersley, 1934), utilize only the external surfaces of the thorax and abdomen and not the under-wing surfaces when parasitizing psyllids and other small insects.

With regard to those members of the Trombidioidea whose larvae utilize insect hosts, in general, there are less systematic data on the range of hosts and the sites of parasitic attachment than in the case of the Erythraeoidea. This means that at present it is not possible to offer any detailed discussion of the morphological and functional adaptations of these larvae and their adults. This is particularly so where there is some unusual structural modification, such as, for instance, the anterior scutalae of the larva of *Chyzeria hirsti*, or the hind tarsi in the larvae of *Ettmuelleria* Oudemans, 1911 and *Eutrombidium* Verdun, 1909.

CHARACTERISTICS OF LARVAL TROMBELLIDAE

Earlier an attempt at a formal definition for larval Trombellidae was deferred. With the redescription or description of four species of *Chyzeria* in the present paper plus the rearing of *Audyana* Womersley 1954, and with the knowledge that *Trombella* Berlese 1887 and *Womersleyia* Radford 1946 are synonyms, it is proposed to examine what characteristics separate them and the genera *Nothotrombicula* Dumbleton, 1947 and *Ralphaudyna* Vercammen-Grandjean *et al.*, 1974, based on larvae, and also presumed to belong to the Trombellidae, from other trombidioid (or related) mites.

This group of larval trombidioid mites has the following characteristics

(1) coxal formula 2, 1, 1

(2) leg segmental formula:
- *(a)* 7, 7, 7 *Chyzeria; Nothotrombicula; Ralphaudyna*
- *(b)* 7, 6, 6 *Audyana*
- *(c)* 6, 6, 6 *Trombella*

(3) AM scutalae:
- *(a)* absent *Chyzeria; Nothotrombicula*
- *(b)* present as such *Trombella; Audyana*
- *(c)* present as 'presensillae'* *Ralphaudyna*

(4) sternal formula 0, 0, 2

(5) vestigiotibialae 1, 0, 0

(6) vestigiogenualae 1, 1, 0

(7) solenotibialae:
- *(a)* 0, 0, 0 *Chyzeria;* or
- *(b)* 2, 2, 2 *Audyana;* or
- *(c)* 2, 2, 0 *Trombella* (V.-G., 1972)

(8) solenogenualae:
- *(a)* 0, 0, 0 *Chyzeria;* or
- *(b)* 1, 1, 1 *Trombella, Nothrotrombicula;* or
- *(c)* 2, 1, 1 *Audyana;* or
- *(d)* 2, 1, 2 *Ralphaudyna*

(9) tracheae absent

(10) pedotarsal claws:
- *(a)* 1, 1, 2 *Trombella;* or
- *(b)* 2, 2, 2 *Audyana;* or
- *(c)* 3, 3, 3 *Chyzeria; Nothotrombicula; Ralphaudyna*

(11) palpal tibial claw:
- *(a)* trifid *Chyzeria; Nothotrombicula;* or
- *(b)* bifid *Ralphaudyna; Trombella;* or
- *(c)* quadrifid *Audyana*

(12) idiosoma seta-bases:
- *(a)* expanded *Chyzeria; Ralphaudyna;* or
- *(b)* normal *Trombella; Nothotrombicula; Audyana*

(13) scutum 'nasus':
- *(a)* absent *Chyzeria; Audyana;* or
- *(b)* present *Trombella; Nothotrombicula; Ralphaudyna*

Taking these characteristics in order:

(1) This is a characteristic of *Leeuwenhoekia, Odontacarus*, and *Neotrombidium* (Leeuwenhoekiidae); it thus cannot be taken as a definitive character of a trombellid larva, but includes also the leeuwenhoekiids.

(2) Subcharacter 2 *(a)* is possessed by many trombiculid genera, together with *Apolonia, Womersia*, and in fact members of the Erythraeoidea and Hydrachnellae have this characteristic of all femora divided.

Subcharacter 2 *(b)*, of having only the first femur divided is possessed by other trombiculids, e.g. *Walchia* (Walchiinae), also *Neotrombidium*.

Subcharacter 2 *(c)*, of having all femora undivided, is possessed by the genera *Leeuwenhoekia, Odontacarus, Monunguis* and various others of the Leeuwenhoekiidae; also by *Lassenia* (Johnstonianidae) (see Table 1).

Clearly this character is of no great value at the family classification level.

(3) This is another characteristic which may be present or absent, or present in some degree, and the same occurs with other trombidioids (see Table 1). Similar remarks apply.

(4) This appears to be a constant characteristic. It is also a characteristic of *Leeuwenhoekia, Odontacarus* and *Neotrombidium* (Leeuwenhoekiidae).

(5) Although this character is present uniformly among the genera, it also applies widely among related mites, e.g. *Leptotrombidium, Babiangia* (Trombiculidae), *Leeuwenhoekia* and Neotrombidium (Leeuwenhoekiidae), *Pteridopus*, etc.

It is thus not of much diagnostic value.

(6) This character is also uniform, but occurs also

* Vercammen-Grandjean *et al.* (1974, p. 246)

e.g. in *Leeuwenhoekia* and *Neotrombidium* (Leeuwenhoekiidae), and also in *Pteridopus*.

It also is not of much diagnostic value.

(7) Character 7 *(a)* is shared by *Leptotrombidium, Babiangia, Neotrombidium,* for example. Character 7 *(c)* is shared by *Pteridopus, Polydiscia*.

It is difficult to see how such a widespread and variable character can be considered of much diagnostic use.

(8) It is clear also that character (8), similarly widespread and variable, can be considered of little diagnostic usefulness.

(9) This character is uniform, but also applies to the majority of the trombidioid mites; see Table 1.

(10) It is clear from inspection that the number of pedotarsal claws is in no way diagnostic of the trombellids.

It is apparent also that characters (11), (12) and (13) cannot be used to separate trombellids from other trombidioids.

In a proposal to separate the Trombellinae from the Neotrombidiinae Vercammen-Grandjean (1972, p. 239) proposed the following supposedly differentiating characters for the Trombellinae:

1. a single but trifurcate claw on each anterior and mid leg, two claws on posterior leg tarsus.
2. no microspurs [=vestigialae here] on anterior and mid genu.
3. round urstigma between contiguous anterior and mic [sic, for mid] coxae.
4. uniform porosity on coxae [as against a mosaic pattern over the lateral part of some of the coxae]'.

In 1973 (1973b, p. 109) he used the term Trombellidae, ascribed to Feider (1955), although the term as such appears to have been introduced by Vercammen-Grandjean there. As no formal redefinition appears to have been proposed, it appears reasonable to accept that the characters listed by Vercammen-Grandjean (1972, p. 239) remained as his concept of the differentiating characters of the family Trombellidae, for the larvae. Larval genera accepted by Vercammen-Grandjean (l.c.) as belonging to the Trombellinae were *Womersleyia* and *Audyana*.

If we compare the characters listed above with those discussed in the preceding text of the present article, we find, with respect to character (1) of Vercammen-Grandjean, that with the addition of *Chyzeria* alone to the list the pedotarsal claw pattern may be 1, 1, 2 or 2, 2, 2 or 3, 3, 3 (see my character (10) above).

With respect to Vercammen-Grandjean's character (2), of the possession of a vestigiogenual formula of 0, 0, [0], the formula recorded here is of 1, 1, 0 for all the genera of the Trombellidae considered here, which is the same as the formula for the Neotrombidiinae proposed by Vercammen-Grandjean (*l.c.*), also for *Nothotrombicula*.

With respect to character (3) of Vercammen-Grandjean, above, unless some quantitative measure of ellipticity is to be applied it is difficult to see how such a character can be used. The problem here is not to differentiate the trombellids from the genus *Neotrombidum* and its near relations, but to find one or more criteria which will separate the trombellids from the other trombidioids, at least in the first instance.

For character (4), the presence of a mosaic pattern in the outer parts of coxae I and III in *Neotrombidium* and related genera, this appears to be confined to that group, and is not seen elsewhere among the Trombidioidea.

It would appear therefore that an examination of the available data has not yielded criteria which will allow separation of a larval trombellid with any certainty, although in some cases, where no rearing correlation has been achieved, e.g. for the genera *Nothotrombicula* and *Ralphaudyna,* the resemblances to known larval trombellids are so great that they may be allotted to this family with confidence. At present therefore it is probably justifiable to retain a family Trombellidae, but this has to be based on the adult definition only, and no formal definition of larval Trombellidae can be proposed with any reliability.

This amounts to confirming the view of Robaux (1977b) that, in order to work out the phylogenetic relationships of the Trombidioidea, one cannot rely solely on one aspect of the morphology of these mites, such as that of the larvae or of the adults. In fact Robaux has proposed that biological and ecological factors must also be considered.

Description of a Pygmephorid Mite Phoretic upon an Adult *Chyzeria*.

We now proceed to a description of a species of mite, of the family Pygmephoridae, recorded above as phoretic upon an adult *Chyzeria hirsti* Wom.

Bakerdania workandae sp. nov.
(Figs. 16, 17, 18)

Description of Non-Gravid Adult Female, Holotype ACC226, Mounted.

Colour in life light brown. Length of idiosoma 260μm; length of gnathosoma from tip of chelicerae to posterior superior margin of the cheliceral bases

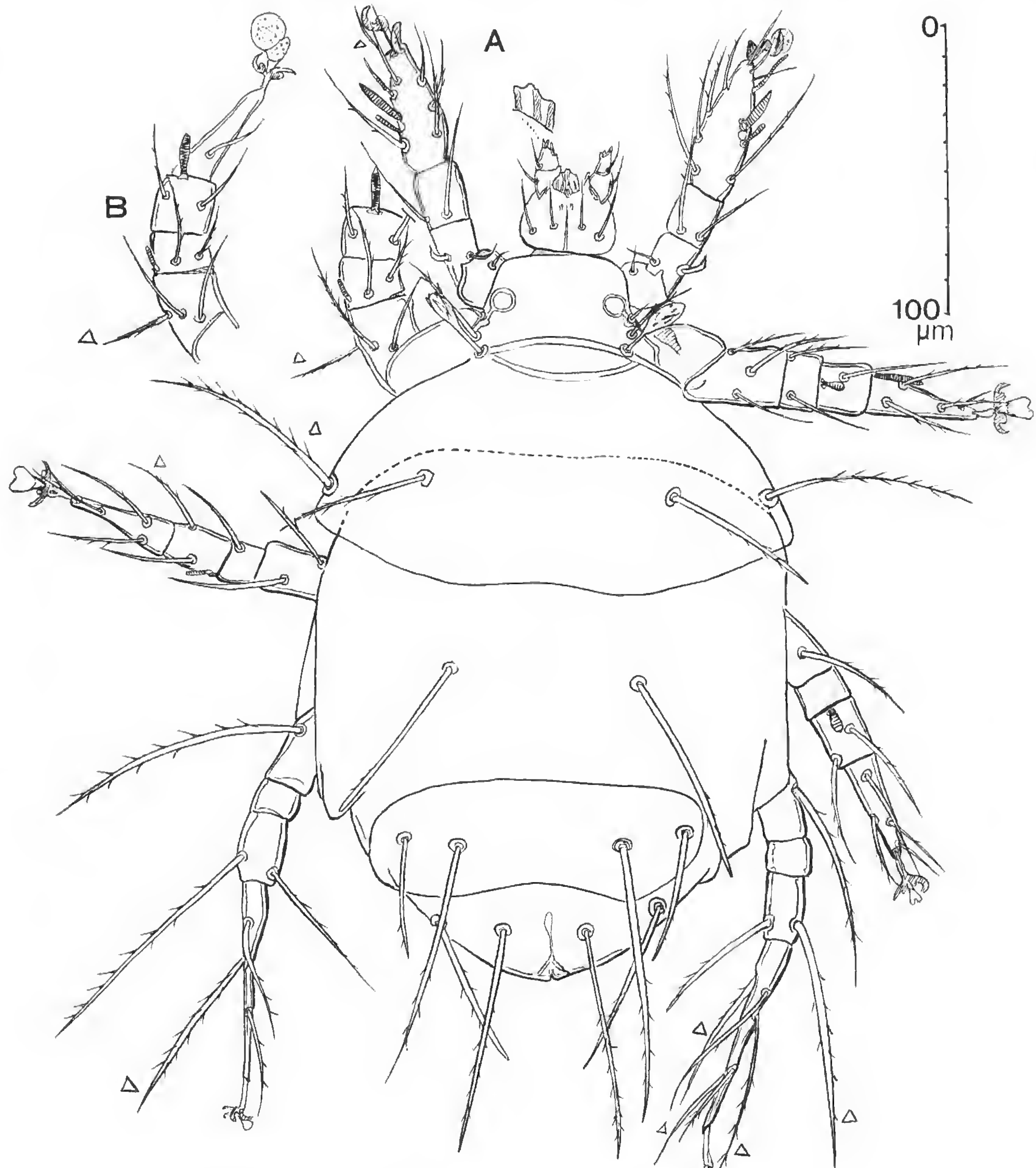

FIG. 16. *Bakerdania workandae* sp. nov. Holotype female. A, Dorsal view. B, Dorsal view left leg II (setae of tarsus II incomplete in B, from obscurity of mount). A, B to scale shown.

28μm; total length of mite from tip of chelicerae to posterior pole of idiosoma 288μm. Width of idiosoma at level of legs III 170μm.

Gnathosoma small, free, subquadrate, 33μm wide. It carries 4 simple spiniform setae dorsally on the cheliceral bases, lateral 23μm long, originate somewhat posterior to medial, which are 20μm long. Ventrally the gnathosoma carries a short spiniform seta (palpal coxala) 14μm long, originating immediately behind the proximal free palpal segment. Both dorsally and ventrally a midline chitinous raphe separates the two gnathobases. Chelicerae small, the stylets not extruded, but confined in the specimen in a small conical cap.

Palpi of two mobile segments. Proximal segment (femur-genu) with a dorsolateral spiniform seta, 11μm long, and distal segment (tibiotarsus) with a similar dorsolateral spiniform seta, 15μm long. Palpal tibiotarsus bears distally a strong broad-tipped tooth, with three or four weakly defined cusps, the lateral-most projecting farthest. Distal segment bears ventrally two solenoidalae, expanded, projecting somewhat anterolaterally. The more posterolateral (solenoidala "1"), about 4 μm long by 1μm wide, is thinner, somewhat clavate; the more medial (solenoidala "2") is larger, 8μm long by 3μm wide, approximately thumb-shaped with an excavated base.

Propodosoma dorsally trapezoidal, widest posteriorly, and with the anterolateral angles rounded; about half as long as wide. Laterally, at about the middle level on each side, is a large circular peritremal opening, 9μm wide, with the centres 37μm apart. Behind and lateral to each peritremal opening is the short anterolateral propodosomal setae, spiniform, 7μm long. Behind and slightly lateral to this seta is the larger posterior propodosomal seta, tapering, pointed, lightly barbed, 29μm long. Behind this, on each side, is a clavate sensillum, 25μm long, by 7μm wide at its thickest part.

Ventral propodosomal setae consist of two more or less transverse rows of 4 setae, total 8; these are tapering, pointed and barbed. The anterior of these arise from the coxal plates ("ventrites") of the first pair of legs. The medial pair of these setae strong, 41μm long, arising at about the middle of the coxal segment; the lateral pair 30μm long, and arise from the cusp between the two leg trochanters ("coxae" of some authors), almost directly below the alveoli of the posterolateral dorsal propodosomal setae. These setae appear as normal type setae, i.e. scobalae, and they are not split or modified in any unusual way. The second row of propodosomal ventralae are similar to the first row; they originate laterally upon a small triangular section of the second coxal plate, at its anterolateral angle, and juxtaposed to the acetabular socket of leg II; medial setae 50μm long, lateral (which is slightly posterior) 52μm long (these two setae are the internal and external ventral setae II of authors). The margins of the circum-gnathosomal foramen are only moderately thickened. Apodemes II transverse. The posterior marginal apodeme of the propodosoma somewhat thickened, more or less linear, running anterolaterally, the two lateral members meeting in a blunted obtuse angle.

Hysterosoma, dorsum: setae long, strong, tapering, pointed, with barbed ciliations. First dorsal pair of setae level with first lateral pair of hysterosomal setae, dorsals 53μm long, laterals 78μm long; dorsals I are 91μm apart. Hind margin of anteromost dorsal plate weakly emarginate. Dorsals II 73μm long, 72μm apart. Dorsals III 91μm long, 59μm apart; laterals III somewhat anterolateral to the dorsals, and 43 μm long. Posterior margin of segment III with distinct smooth median excavation. Dorsals IV ca 90μm long (broken at tip), and centres 28μm apart; laterals IV 63μm long with centres 80μm apart, and a little anterior to dorsals IV.

Hysterosoma, venter: all setae of posterior ventral plate tapering, pointed, with weak barbed ciliations. Medial presternal setae 41μm long with centres 30μm apart, somewhat anterior to lateral presternals which are 53μm long with bases 71μm apart. The latter are a little anterior to the axillary I setae, which are 35μm long with bases 102μm apart. Lateral presternals arise well anterior to apodemes IV, and well lateral to medial presternals. Axillary setae II (arising between the origins of legs III and IV) 53μm long by 98μm apart. Medial poststernal setae are 44μm long by 22μm apart; lateral poststernal setae are 73μm long by 50μm apart. Thus the lateral poststernals are the longest of these setae; and the axillary I setae are the shortest. Apodemes III not clearly defined in the specimen. Apodemes IV are only slightly flexed posteriorly to meet edges of acetabular sockets of legs III. Apodemes V not clearly defined. The posterior margin of the posterior ventral plate is more or less transverse, only a little sinuous. Opisthosoma ventrally entire, with only a minute cleft indicated at posterior pole. The most posterior opisthosomal setae ("caudals") consist of a transverse row of 6 pointed, ciliated setae: lateral pair 19μm long, bases 37μm apart between centres, as usual; the other 4 setae in 2 groups of 2, each lateral group adjoined, the lateral of these 26μm long, medials 32μm long, centres of bases of each pair 3μm apart, the medial of these setae with bases 16μm apart. From the posterior opisthosomal cleft two small "apodemes" diverge in a wishbone-like manner, 17μm long.

Legs as figured. The lengths of the non-fixed part of the legs, to the tip of the tarsal claws, as follows: I 106μm, II 133μm, III 152μm, IV 226μm.

The lengths of the mobile leg segments are as follows (μm) (excluding pedicle and claws in tarsus):

Leg	I	II	III	IV
trochanter*	19	25	33	59
femur	28	34	44	52
genu	18	15	15	14
tibia	56	18	21	27
tarsus	—**	41	37	73

* Cross (1964, 1965) calls this the coxa, and labels subsequent segments accordingly.
** In leg I tibia and tarsus are fused to a single segment.

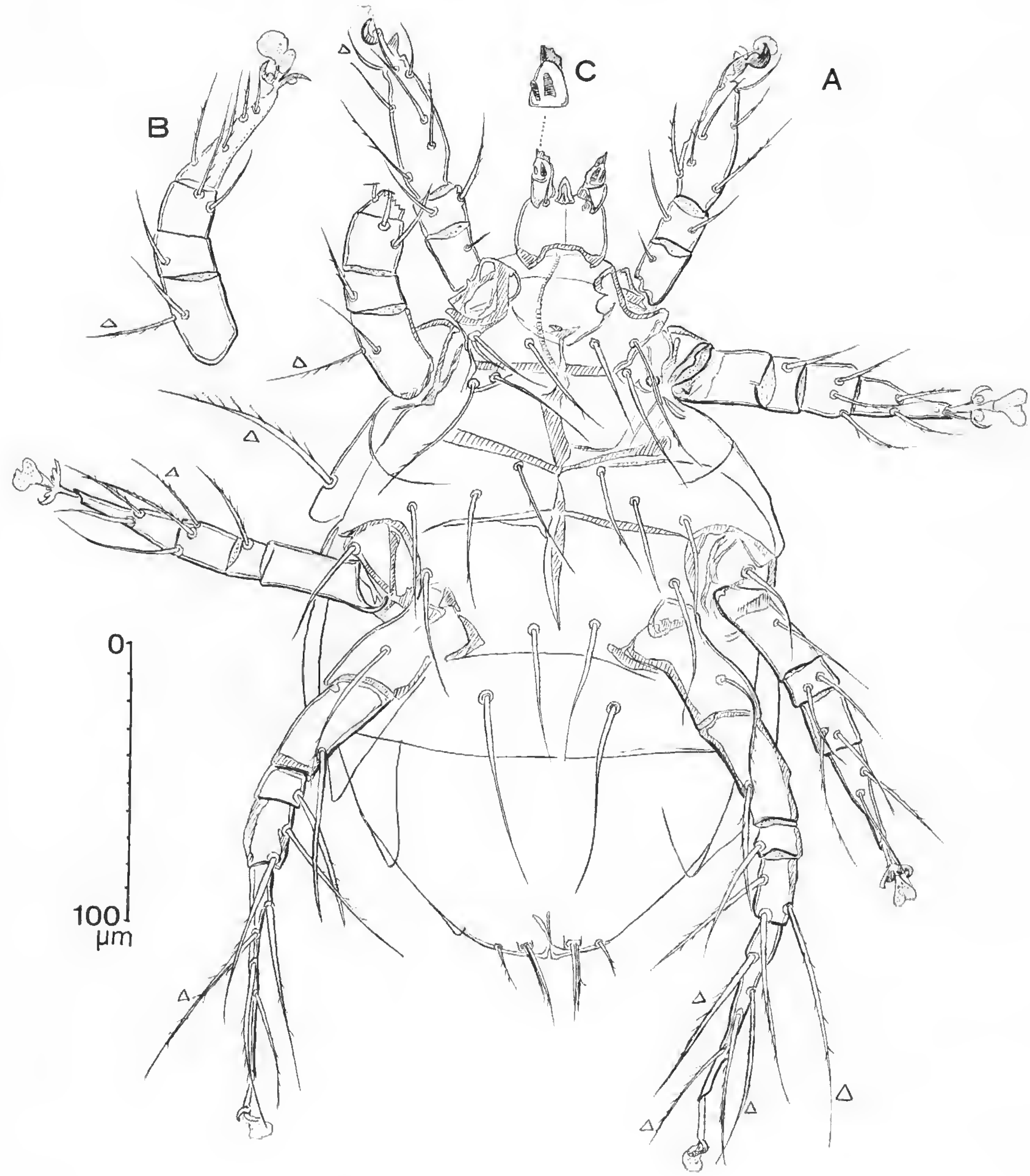

FIG. 17. *Bakerdania workandae* sp. nov. Holotype female. A, Ventral view. B, Ventral view of left leg II (setae of tarsus II incomplete in B, from obscurity of mount). (A, B to scale shown.) C Distal segment of left palp, further enlarged.

The setation formula of the legs is (see Figs. 16, 17):

Leg	I	II	III	IV
trochanter	1d	0	1v	1v
femur	1d, 1v, 1l ('c')	3d, 0-1v	1d, 1v	1d, 1v
genu	2d, 2v	2d, 1v	2v	1p
tibia	8d, 7v +3So	1d, 1l, 2v+So	2d, 2v, +So	2d, 2v
tarsus	—	4d, 4v +So	4-5d, 2v	4d, 2v

Details of leg specialized setae are as follows:

Leg I. The tip of 'seta c' of femur I (a modified scobala) somewhat falciform and sharply proflexed. On dorsum of tibiotarsus I are two expanded solenoidalae, and more distally one attenuated solenoidala, and more distally again a retroflexed sensory seta; at the "proral situation" a further seta, probably a solenoidala.

Leg II. On tibia II the proximal end is overlain dorsally by a stout clavate solenoidala. On tarsus II a similar clavate solenoidala lies dorsally and proximally.

Leg III. On tibia III a clavate solenoidala arises proximally and dorsally.

Tarsal claws: On leg I single, on a short pedicle, and the tibiotarsus I distally and ventrally carries a short "thumb-process". On tarsi II-IV the claws are double, each claw strong, falciform, and with a basal tuberosity or "cushion"; the middle (neomedian) claw has a chitinized wishbone-like basal piece, from which an adhesive membrane spreads out fanwise, lobate.

Material Examined

Holotype specimen, ACC226, to be deposited in South Australian Museum collection. Taken attached to central dorsal area of adult *Chyzeria hirsti* Wom., specimen ACB320, from under stone, Workanda Creek, National Park, Belair, South Australia, 1 August 1948, R. V. Southcott.

Notes on Behaviour

On capture the adult *Chyzeria hirsti* was examined under a binocular microscope to see if it carried any larval *Chyzeria*. None was observed. I recorded "To my surprise I found a small brown mite in the cavity of its back as shown [see Fig. 18]. . . It was cleaning the back part of the abdomen by hooking its last pair of legs over, in the same way as a fly does".

The relationship between the adult female pygmephorid mite and the adult *Chyzeria hirsti* is presumably best described as a phoretic one. The relationship is unlikely to be a parasitic one in view of the small size of the cheliceral stylets of pygmephorids, and the fact that the pygmephorids, in a restricted sense, are not known to be parasitic; a number of species are now known to be fungus-feeders (see e.g. Wicht (1970), Kosir (1975) and the further references they quote).

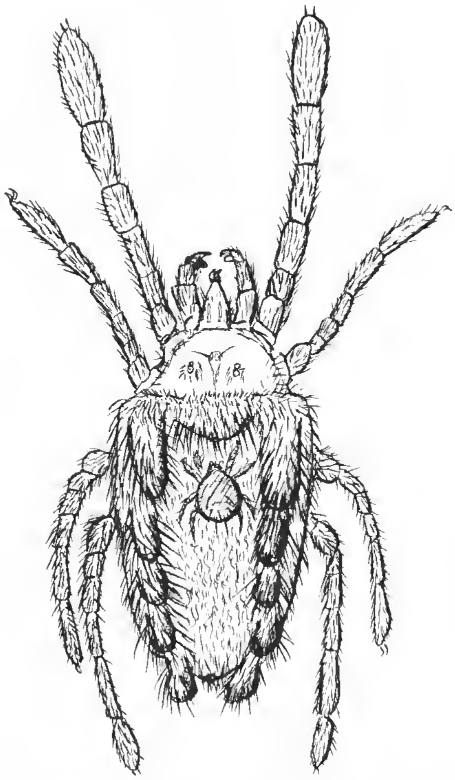

FIG. 18. Adult male *Chyzeria hirsti* Womersley carrying an adult female pygmephorid mite, the holotype of *Bakerdania workandae* sp. nov., in the space on the dorsum between the dorsal idiosomal processes. From life, redrawn from a sketch made at the time.

As a phoretic host, it would appear that the adult *Chyzeria hirsti* is not likely to be efficient. Although *Chyzeria hirsti* adults are, among similar-sized soil-inhabiting Australian adult trombidoid mites, relatively fast-moving, it would seem unlikely that they would disperse over other than small distances.

Remarks on Classification

In the systematic placing of *Bakerdania workandae* I have been initially guided by the works of Krczal (1959) and Cross (1964, 1965). Cross produced a monographic revision of the genera of the Pyemotidae *(sensu lato)*, and this was to have been followed by a first application of the revision to localized faunas. The large monographic revision was published as Cross (1965) and contained a division of the old genus *Pygmephorus* Kramer, 1877 into the new genera *Acinogaster* Cross 1965, *Parapygmephorus* Cross 1965, *Pseudopygmephorus* Cross 1965, and *Neopygmephorus* Cross 1965, as well as a number of subgenera. Cross applied these names in his paper studying the relevant mite fauna of Macquarie Island, which appeared earlier as Cross (1964). By then he had reached the conclusion that the separation of the genera named might not be entirely valid, as the Macquarie Island survey immediately revealed species with characters belonging to one or more of the genera proposed. In response to this he placed the five Macquarie Island species in *Neopygmephorus*, with the comment that "In the above paper [Cross, 1965], I divided the tribe Neopygmephorini into four new genera . . . . Acquisition of new material since then indicates that this grouping is probably unjustified, and that it is more realistic to join at least *Pseudopygmephorus* and *Neopygmephorus* . . . .". Of the two last-named generic names, *Pseudopygmephorus* has page priority, but Cross (1964) presumably chose to use the name *Neopygmephorus* on the ground that a tribal name was based upon it, although this is not stated.

Subsequently Cross (1970) has shown that *Neopygmephorus* is a junior synonym of *Bakerdania* Sasa 1961, and this has been accepted by other workers on the Pygmephoridae and Pyemotidae, e.g. Mahunka (1973a, b), Rack (1974).

A further complication has since been discovered which may have an important bearing on the generic placing of "pyemotid" mites. This is the observation that in certain of the pygmephorid and pyemotid mites the adult females may appear in two forms, the phoretomorph and the non-phoretomorphic forms, which have different generic placements in existing classifications, e.g. *Siteroptes* and *Pediculaster*, or *Siteroptes* and *Pygmephorellus* (Rack 1974; Cross and Moser 1965; Moser and Cross 1975). So far this phenomenon does not appear to have been recorded with those pygmephorid mites allotted to the generic forms proposed by Cross in 1965, but clearly this possibility cannot be excluded.

In recent years no full revision of the Pygmephoridae and Pyemotidae has been published*, and at present the only general work on the pygmephorids and pyemotids of the world is by Krczal (1959). In this latter the old genus *Pygmephorus* Kramer 1877 was not divided into subgenera. By Krczal's key the species described above comes to the caption of *Pygmephorus kochi* Krczal 1959, from which there are a number of morphological differences. Among these are the more spindle-shaped tibiotarsi I, the presence of a strong opposition-piece (anvil, or *incus*) to the claw of tibiotarsus I, the far more elongate tarsus IV (three times the length of tibia IV, as against twice in the case of *P. kochi*) and a number of other factors. *P. kochi* was one of the 16 species or subspecies placed by Cross (1965, p. 224) tentatively in his genus *Pseudopygmephorus*.

By the generic table of Cross (1965) the species described above comes within *Neopygmephorus* Cross 1965, subg. *Neopygmephorus*. Cross (1965, p. 230) gave a list of the already described "pyemotids" which he believed should be placed in this subgenus, amounting to 17 species and one subspecies, but did not submit a diagnostic key to separate them. The only recent key to a group of related pyemotid mites from the Australian region known to the present author is Cross's (1964) study of the fauna from Macquarie Island, allotted to *Neopygmephorus*. These indicate the wide-spread distribution of these mites, as species known hitherto from Europe, Japan and North America were represented.

Accepting that the species described above belongs to *Neopygmephorus* as used by Cross in his 1964 paper, i.e. to *Bakerdania* Sasa 1961, and using that key, one finds that *B. workandae* comes closest to *B. arvorum* (Jacot 1936), originally described from North America by Jacot (*l. c.*) but now known to occur also in Macquarie Island (Cross 1964), Germany (Rack 1967), Jugoslavia (Mahunka 1975b) and Tunisia (Mahunka 1978) and to *B. togata* (Willmann 1942), originally described from Germany, but now also recorded from Macquarie Island (Cross 1964), Hong Kong (Mahunka 1975a) and Africa (Mahunka 1976). Rack (1967 p.10) places *P. arvorum* Jacot, 1936 in *Pseudopygmephorus* Cross, as did also Cross (1965, p. 224).

From these two species *B. workandae* may be separated as follows:

B. workandae has 6 caudal setae instead of the 4 which occur in *B. arvorum*.

B. workandae has the lateral presternal setae well lateral to the medial presternals, while in *B. togata* the lateral presternal setae are only slightly lateral to the medial presternals. In *B. workandae* the lateral poststernal setae are significantly longer than trochanter IV, while in *B. togata* the lateral poststernals are significantly shorter than trochanter IV (see further in Cross 1964; Willmann 1942).

A number of papers have been written on the pyemotid fauna of the world since the acceptance of the status of *Bakerdania* as a senior synonym of *Neopygmephorus;* some of these describe new species of *Bakerdania*. Of the new species described, in the literature available to me from the extensive reprint library of the South Australian Museum, and in my own and other libraries, there is only one which appears to have a significant resemblance to *B. wor-*

*In recent years further taxonomic changes at the family and suprafamilial levels have been introduced for these mites. Thus the superfamily names Pyemotoidea and Pygmephoroidea have been used by some authors (see further in Krantz, 1978). These taxonomic changes are, however, outside the scope of the present work.

kandae sp. nov. This is *B. discrepata* Mahunka, 1973, from Ghana (1973b, p. 318). Both of these species are known from only a solitary female; males are unknown for them. These two females may be separated as follows:

Tarsus IV (excluding claws and pedicle) less than twice as long as tibia IV. Tibiotarsus I short, ellipsoidal. Distal solenoidala on tibiotarsus I short, about half as long as the immediately proximal thick solenoidala . . . *B. discrepata* Mahunka 1973

Tarsus IV (excluding claws and pedicle) more than twice as long as tibia IV. Tibiotarsus I spindle-shaped. Distal solenoidala of tibiotarsus I long and attenuated, longer than the proximal thick solenoidala . . . *B. workandae* sp. nov.

Acknowledgement

I am indebted to Evert E. Lindquist, Senior Acarologist, Biosystematics Research Institute, Ottawa, Canada, for helpful criticism of this paper.

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